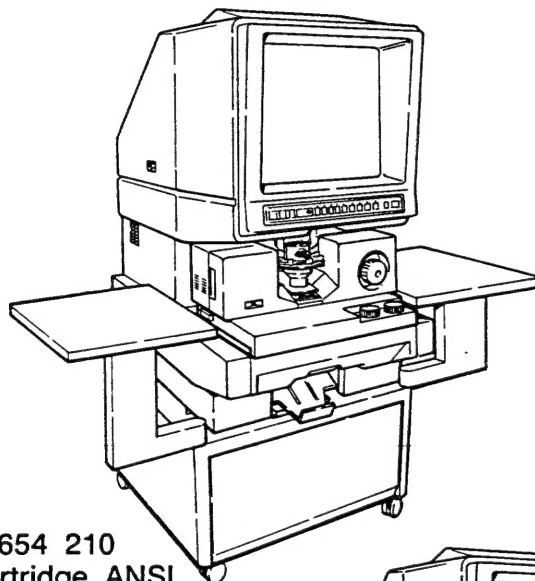
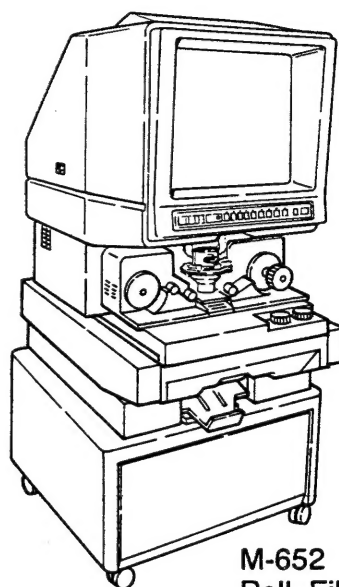


Field Service Handbook

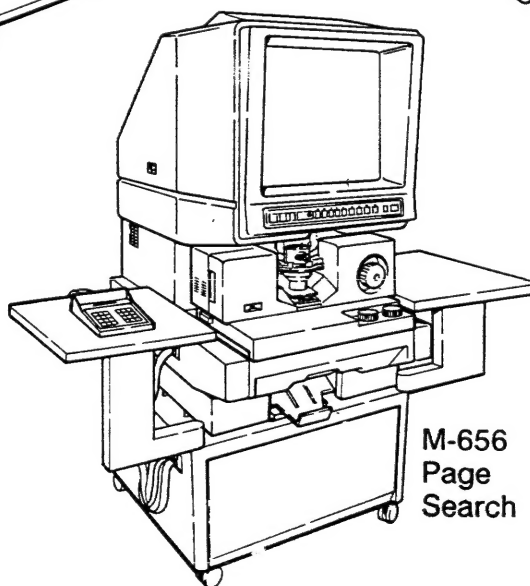
M7530/7540 Accessories



M-654 210
Cartridge ANSI
Transport



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Roll Film
Transport



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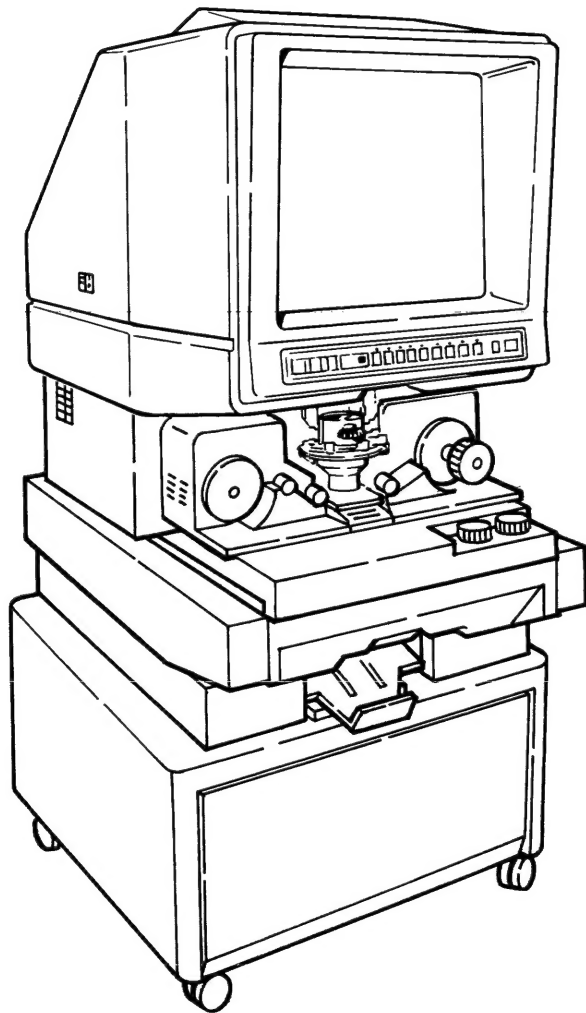
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3M Office Systems Division

3M

Field Service Handbook

M652 110 Roll Film Transport



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* Located in binder pocket

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1-1. DESCRIPTION

The 3M Model 652 110 RFT (Roll Film Transport) is a self-contained motorized 16 mm and 35 mm roll film transport used on the 3M Model 7530 MFB 1100 Reader-Printer.

1-2. APPLICATIONS

The M-652 110 RFT is typically installed on the M-7530 MFB 1100 where 16 mm or 35 mm roll film is used.

1-3. MACHINE SPECIFICATIONS**Shipping Dimensions**

Height: 410 mm (16.1 in.)
Depth: 550 mm (21.7 in.)
Width: 640 mm (25.2 in.)

Machine Dimensions

Height: 175 mm (6.9 in)
Depth: 500 mm (19.7 in)
Width: 365 mm (14.4 in)

Shipping Weight

12.4 kg (27.3 lb)

Machine Weight

10 kg (22 lb)

Power Requirements

27 VAC, 3.8 amperes, 50/60 Hz

Power Consumption

23 watts average in Standby Mode
80 watts average in Film Search Mode

Noise Level

70 dbA maximum

Operating Environment

10° C to 30° C (50° F to 86° F) 20% to 80% RH

Microfilm Accommodated

16 mm roll film
35 mm roll film
Diazo
Dry Diazo
Vesicular
Silver Halide
Maximum 2.5 mil thick film capacity of
67.5 M (221 ft)

* All specifications are approximate

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2-1. GENERAL

Read the installation instructions completely before setting up the machine.

2-1. UNPACKING

Note

This machine was designed to be easily set-up by a customer. Set-Up Instructions are included in each shipping carton.

The M-652 110 RFT is shipped assembled except for the Glass Flat Assembly. Perform the following inspection upon receipt of the machine:

1. Inspect the Shipping Carton for damage that could indicate damage to the machine.

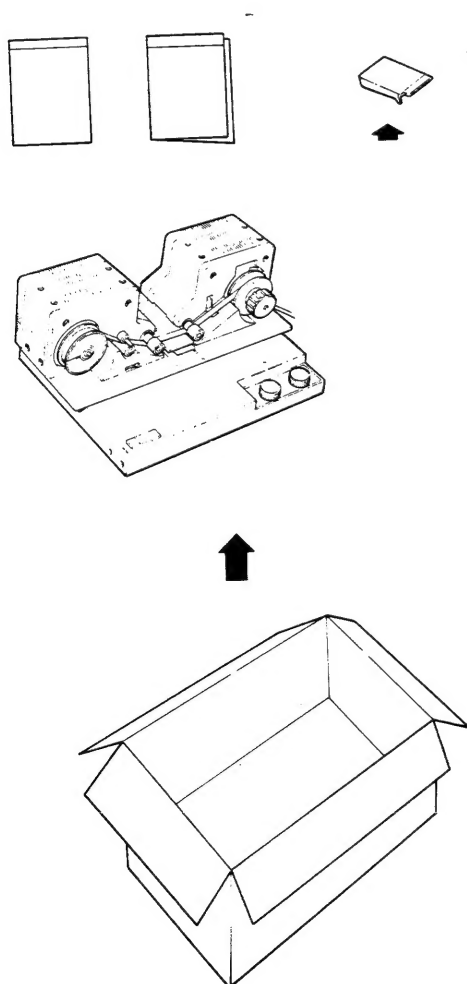


Figure 2-2A

2. Inspect the machine and un-installed components (Figure 2-2A) for damage or missing parts.
3. Report any damage by completing the Product Registration Form and returning it to:

Quality Assurance
Office Systems Division/3M
235-2B-08 3M Center
St. Paul, MN 55101-9924
Phone (612) 733-4386

2-3. SET-UP

1. Remove both red Shipping Screws from the bottom of the machine (Figure 2-2B).

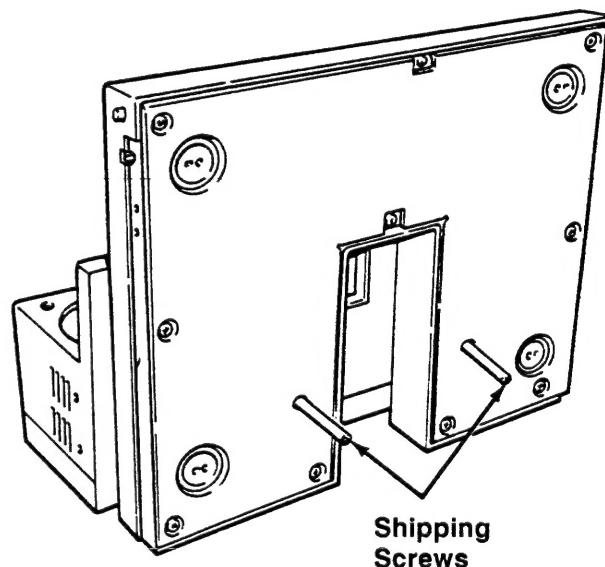


Figure 2-2B

2. Press the Power Switch of the Reader-Printer to "0" (OFF).
3. Remove the Lens Assembly from the Reader-Printer (See MFB 1100 Operating Instructions).
4. Remove the present Film Handler from the Reader-Printer (See MFB 1100 Operating Instructions).

Note

All new M-7530 Reader-Printers will have the Interface Connectors on the left side. All new M-652 Roll Film Transports will also have the Interface Connectors on the left side. If the M-7530 has the Interface Connectors on the right side and the M-652 on the left side, move the harness to the right using the following procedure:

- a. Turn the M-652 over and remove the Bottom Cover (Disassembly 4-2.6, page 4-4).
 - b. Remove all Cable Clamps from the Wiring Harness within the Base.
 - c. Remove the Strain Relief.
 - d. Route the harness to the other side and through the hole in the right side of the Base.
 - e. Reinstall the Strain Relief and Bottom Cover.
5. Align the Roll Film Transport within the track of the Accessory Table of the Reader-Printer and push the Roll Film Transport in until the Latches engage (Figure 2-2C).

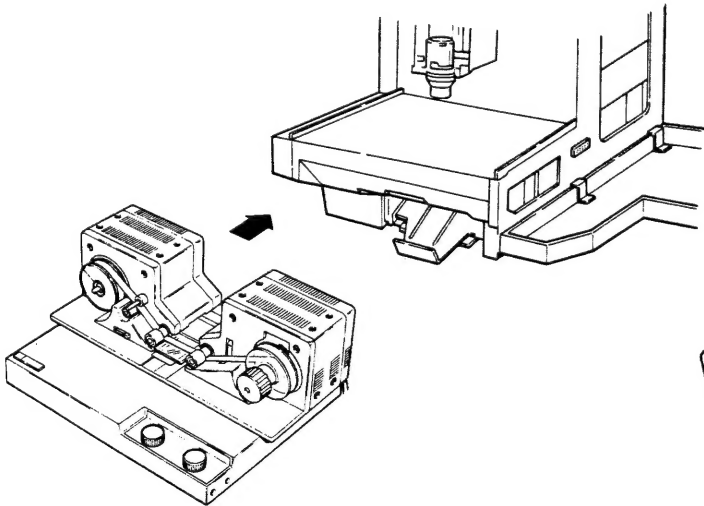


Figure 2-2C

6. Plug the Wiring Harness of the Roll Film Transport into either of the connectors on the left side of the Reader-Printer for newer machines, or open the Right Side Door of the Reader-Printer and plug the Wiring Harness of the Roll Film Transport into either connector (Figure 2-2D) for older machines.

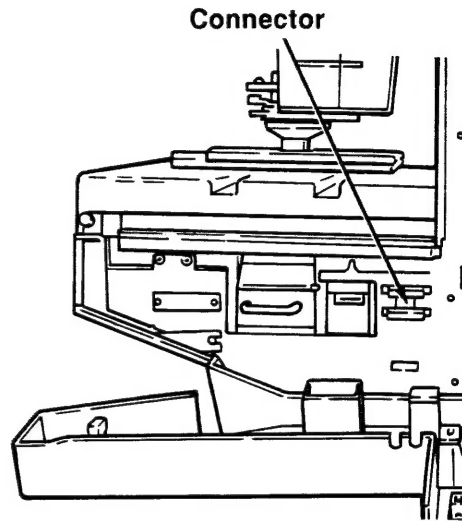


Figure 2-2D

7. Install the Glass Flat Assembly (Figure 2-2E).

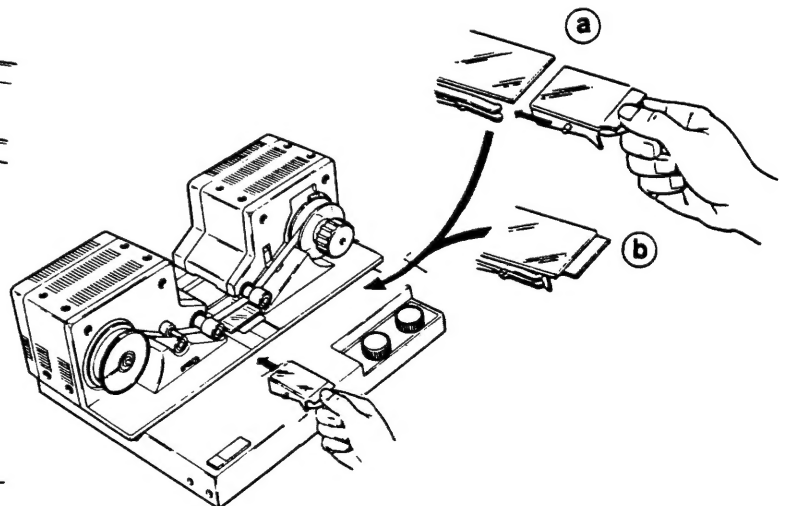


Figure 2-2E

8. Reinstall the Lens Assembly (See MFB 1100 Operating Instructions).

9. Turn the Film Speed Control to "0" degrees (Figure 2-2F).

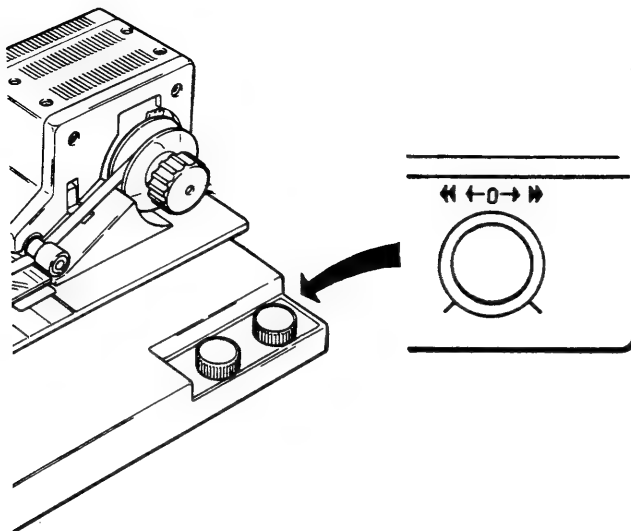


Figure 2-2F

Note

The Roll Film Transport is shipped for 16 mm film. For 35 mm film, pull off the 3 Capstan Rollers, turn them around, and reinstall. Pull out the Take-Up Reel Flange. See Figure 2-2G.

Pull off and flip 180°
for 16 mm or 35 mm film

Capstan Rollers

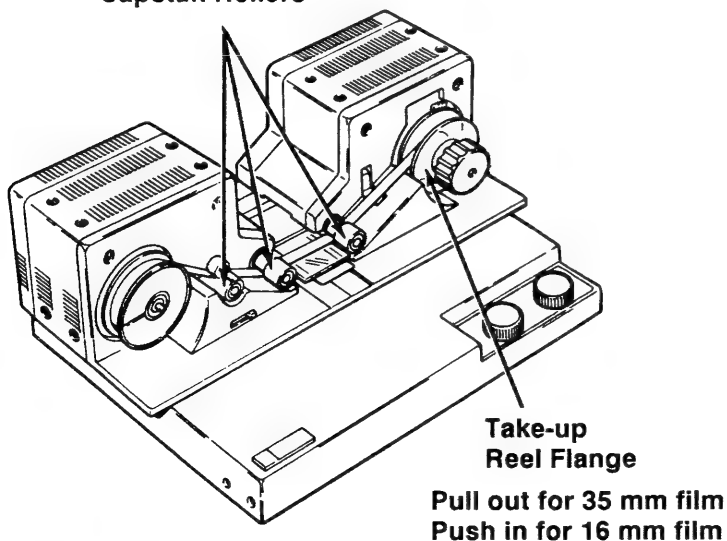


Figure 2-2G

2-4. ADJUSTMENTS

There are no initial adjustments to be made.

2-5. INITIAL CHECK

1. Press the MFB 1100 Power Switch to "1" (ON).
2. Load film (See 110 RFT Operating Instructions).
3. Turn the Film Speed Control clockwise about 90 degrees. The film should move quickly to the right and the Lower Glass Flat should move down.
4. Return the Film Speed Control to 0 degrees. The Lower Glass Flat should clamp and the film should not move.
5. Turn the Film Speed Control counter-clockwise about 90 degrees. The film should move to the left and the lower Glass Flat should move down.
6. Return the Film Speed Control to 0 degrees. The Lower Glass Flat should clamp and the film should not move.
7. Turn the Film Speed Control counter-clockwise until the Film runs out. The Take-Up Reel should stop.

CAUTION

Two mandatory kits are required for proper operation of this machine:

- Film Threading Decal Kit
78-8059-6693-0
- Shutdown PWA Kit 78-8060-7388-4

Install these kits before leaving the machine with the customer.

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3-1. LOWER GLASS FLAT SOLENOID

Specification

The Lower Glass Flat should move down when film is moved at a medium speed and clamp when film is moved at a slow speed or film is stationary.

Measurement

1. Switch ON the Reader-Printer.
2. Load a reel of test film.
3. Turn the Film Speed Control slightly clockwise. Film should move slowly to the right.
4. Turn the Film Speed Control fully clockwise. The Lower Glass Flat should move down and film should move quickly to the right.
5. Return the Film Speed Control to "0" degrees. Film should not move and the Lower Glass Flat should clamp.
6. Turn the Film Speed Control slightly counterclockwise. Film should move slowly to the left.
7. Turn the Film Speed Control fully counterclockwise. The Lower Glass Flat should move down and film should move quickly to the left.
8. Return the Film Speed Control to "0" degrees. Film should not move and the Lower Glass Flat should clamp.

Adjustment

1. Switch OFF the Reader-Printer
2. Disconnect the M-652 Wiring Harness and remove the Roll Film Transport.
3. Remove the Rear Cover (Disassembly 4-2.1, page 4.1).
4. Remove the Top Right Cover (Disassembly 4-2.3, page 4-2).

5. Loosen the Adjustment Screws securing the Lower Glass Flat Solenoid (Figure 3-1A) and move the solenoid to the left to cause the Lower Glass Flat to open further.

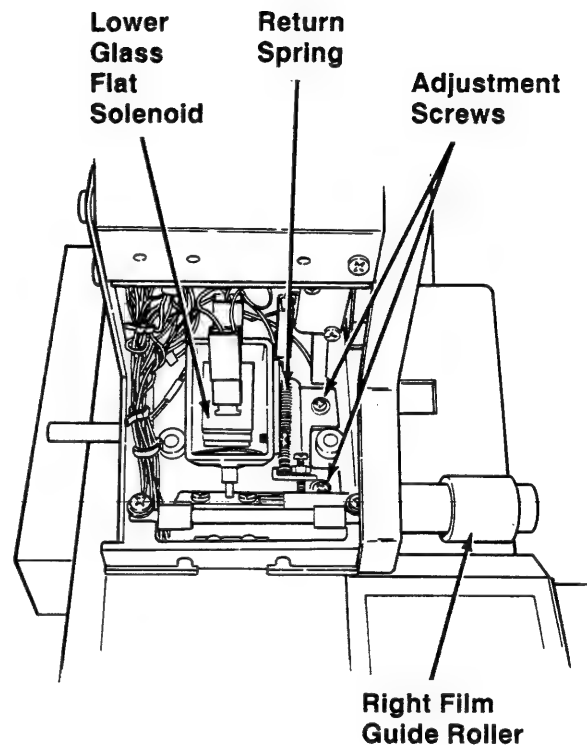


Figure 3-1A

6. Tighten the Adjustment Screws.
7. Move the right end of the Return Spring (Figure 3-1A) to a hole further to the right to increase tension.
8. Reconnect the M-652 Wiring Harness with the M-7530 and repeat Measurement Steps 1 through 8 and readjust as required.

3-2. BRAKE SOLENOID AND BRAKE DISC**Specification**

No film movement when power is applied and the Film Speed Control is at "0" degrees.

The gap between the Metal Plate and the Brake Disc should be 0.2 mm to 0.4 mm (0.008 in. to 0.016 in.).

The gap between the Rollers and Brake Disc should be 0.2 mm to 0.4 mm (0.008 in. to 0.016 in.).

Special Tools

Feeler Gauge

Measurement

1. Switch ON the Reader-Printer.
2. Load film and turn the Film Speed Control to 0 degrees. The Lower Glass Flat should clamp and the film should not move.
3. Turn the Film Speed Control clockwise and wind the film on the Film Take-Up Spool until the Stock Spool is almost empty.
4. Turn the Film Speed Control to 0 degrees. The Lower Glass Flat should clamp and the Film Reel should not turn.
5. Turn the Film Speed Control counterclockwise and completely rewind the film.
6. Switch OFF the Reader-Printer.
7. Disconnect the M-652 Wiring Harness.
8. Remove the Roll Film Transport.
9. Remove the Top Right Cover (Disassembly 4-2.3, page 4-2).
10. Remove the Power PWA (Disassembly 4-3.1, page 4-5).
11. Remove the Film Advance Motor (Disassembly 4-3.3, page 4-6).
12. Unhook the Tension Spring (Figure 3-2A).
13. Turn the Manual Scan Control quickly either direction. The shaft should turn with no resistance.
14. Insert a 0.305 mm (0.012 in) Feeler Gauge between the Metal Plate and the Brake Disc (Figure 3-2A). The gauge should be able to move with some resistance.
15. Insert a 0.305 mm (0.012 in) Feeler Gauge between the Disc Roller and Brake Disc (Figure 3-2A). The gauge should be able to move with some resistance.

Adjustment

1. Turn the Manual Scan Control until the Set Screw securing the Brake Disc is accessible through the access port in the right side of the Rocker Arm.
2. Loosen the Set Screw securing the Brake Disc. (Figure 3-2A).

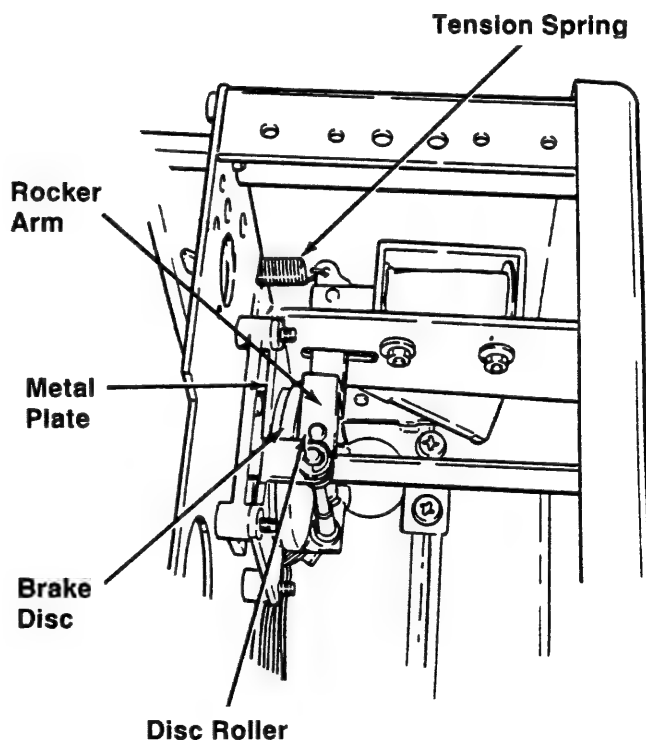


Figure 3-2A

3. Pull the Brake Disc away from the Metal Plate and insert a 0.305 mm (0.012 in.) Feeler Gauge between the Metal Plate and Brake Disc (Figure 3-2A).
4. Move the Brake Disc against the Feeler Gauge and tighten the Set Screw.
5. Place the Tension Spring in the center position (Figure 3-2A).

Note

If the film speed is too slow, move the Tension Spring to the inner position. If the film speed is too fast, move the Tension Spring to the outer position.

6. Repeat Measurement Steps 1 through 4 and readjust as required.

3-3. DRIVE BELTS

3-3.1. FILM FORWARD MOTOR DRIVE BELT

Specification

The Film Forward Motor Drive Belt should have a 4 mm to 5 mm (0.16 in. to 0.20 in.) deflection.

The Film Forward Motor should exert a 1.0 kg (35.27 oz.) force on the belt.

Special Tools

Spring Tension Scale
Ruler

Measurement

1. Switch OFF the Reader-Printer.
2. Disconnect the M-652 Wiring Harness.
3. Remove the Roll Film Transport (110 RFT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
5. Remove the Power PWA (Disassembly 4-3.1, page 4-5).
6. Place a Ruler near the center of the Film Forward Drive Belt (Figure 3-3A) and push down. The deflection should measure 4 mm to 5 mm (0.16 in. to 0.20 in.)

Adjustment

1. Loosen the mounting screws securing the Film Forward Motor (Figure 3-3A).

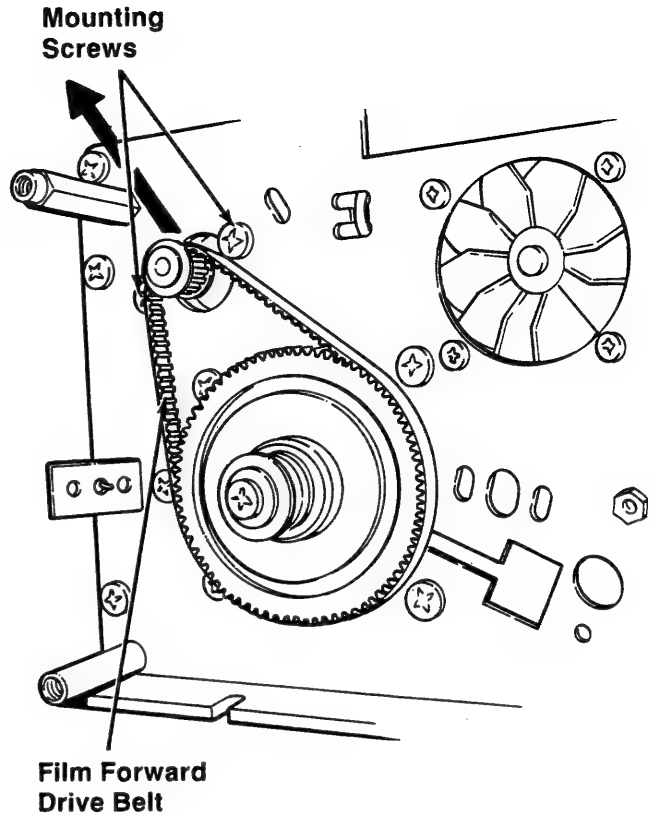


Figure 3-3A

2. Place a Spring Tension Scale on the Film Forward Motor Shaft and pull until the scale reads 1.0 kg (35.27 oz.).
3. Tighten the mounting screws.
4. Repeat Measurement Step 6 and readjust as required.

3-3.2. FILM REVERSE MOTOR DRIVE BELT

Specification

The Film Reverse Motor Drive Belt should have a 4 mm to 5 mm (0.16 in. to 0.20 in.) deflection.

The Film Reverse Motor should exert a 1.0 kg (35.27 oz.) force on the belt.

Special Tools

Spring Tension Scale
Ruler

Measurement

1. Switch OFF the Reader-Printer.
2. Disconnect the M-652 Wiring Harness.
3. Remove the Roll Film Transport.
4. Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
5. Remove the Control PWA (Disassembly 4-3.2, page 4-5).
6. Place a Ruler near the center of the Film Reverse Motor Drive Belt (Figure 3-3B) and push down. The deflection should measure between 4 mm and 5 mm (0.16 in. to 0.20 in.).

Adjustment

1. Loosen the mounting screws securing the Film Reverse Motor (Figure 3-3B).

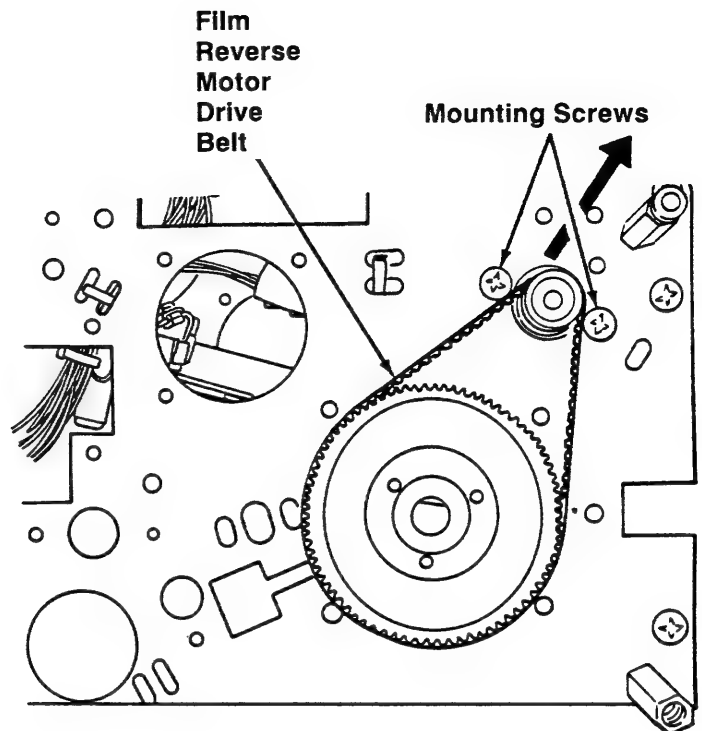


Figure 3-3B

2. Place a Spring Tension Scale on the Film Reverse Motor Shaft and pull until the scale reads 1.0 kg (35.27 oz.).
3. Tighten the mounting screws.
4. Repeat Measurement Step 6 and readjust as required.

3-4. OVERLOAD CLUTCH

Specification

Film should not break if a force is applied to the film spool during take-up.

The Overload Clutch breakaway should be 1.6 kg to 2.0 kg (56.4 oz. to 70.5 oz.).

Special Tools

Spring Tension Scale

Measurement

1. Rewind film from the Take-Up Reel.
2. Switch OFF the Reader-Printer.
3. Disconnect the M-652 Wiring Harness.
4. Remove the Roll Film Transport.
5. Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
6. Remove the Power PWA (Disassembly 4-3.1, page 4-5).
7. Turn the Manual Scan Control until the film slot in the outer reel flange is at top dead-center (Figure 3-4A).

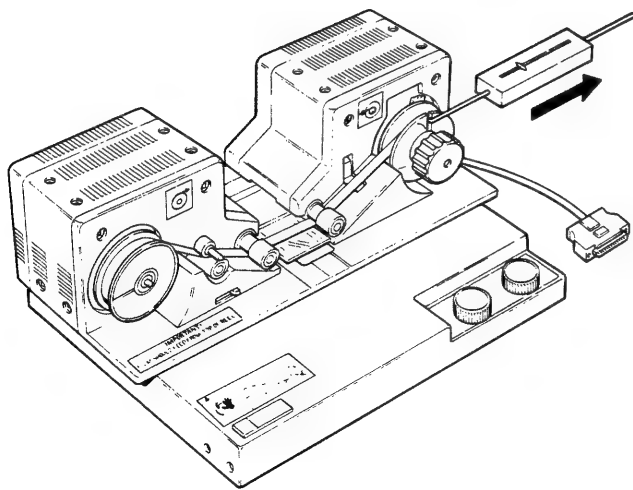


Figure 3-4A

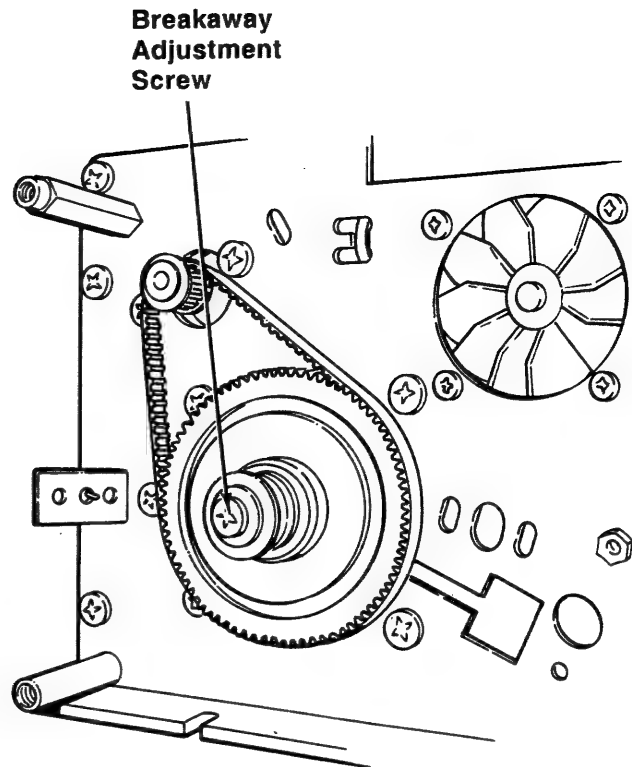


Figure 3-4B

8. Insert the bent end of the Spring Tension Scale in the film slot.
9. Holding the Take-Up Pulley with your hand, slowly pull the scale straight to the right of the machine. The scale should read 1.6 kg to 2.0 kg (56.4 oz. to 70.5 oz.) at breakaway.
10. Repeat Step 8 several times to ensure consistent readings.

Adjustment

1. To increase breakaway, turn the Breakaway Adjustment Screw (Figure 3-4B) clockwise.
2. To decrease breakaway, turn the Breakaway Adjustment Screw counterclockwise.
3. Repeat Measurement Steps 6 through 9.

3-5. FILM SPEED CONTROL

Specification

No film movement whenever the Film Speed Control is set at "0" and the Brake Solenoid should deenergize.

Measurement

1. Switch ON the Reader-Printer.
2. Load film and turn the Film Speed Control 90 degrees either direction. Film should move to right or left and the Brake Solenoid should energize.
3. Turn the Film Speed Control to 0 degrees. The Film should not move and the Brake Solenoid should deenergize.

Adjustment

1. Switch OFF the Reader-Printer.
2. Disconnect the M-652 Wiring Harness.
3. Remove the Roll Film Transport.
4. Remove the Top Left Cover (Disassembly 4-2.2, page 4-1).
5. Set the Film Speed Control to "0".
6. Connect the M-652 Wiring Harness with the Reader-Printer.
7. Switch ON the Reader-Printer.
8. Adjust R78 of the Control PWA (Figure 3-5A) for 0 VDC.

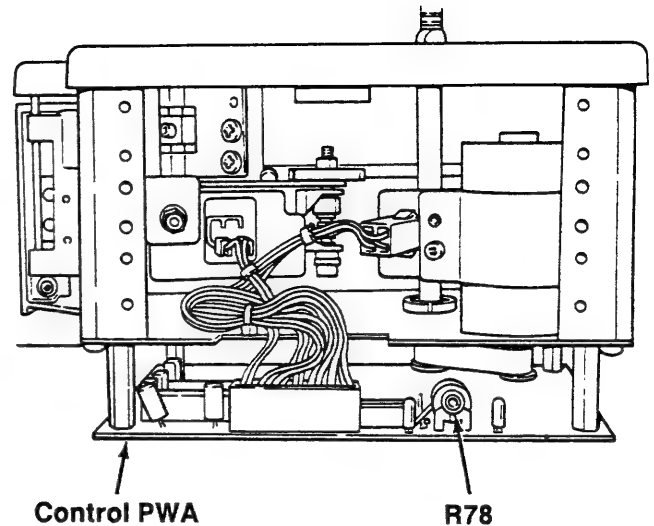
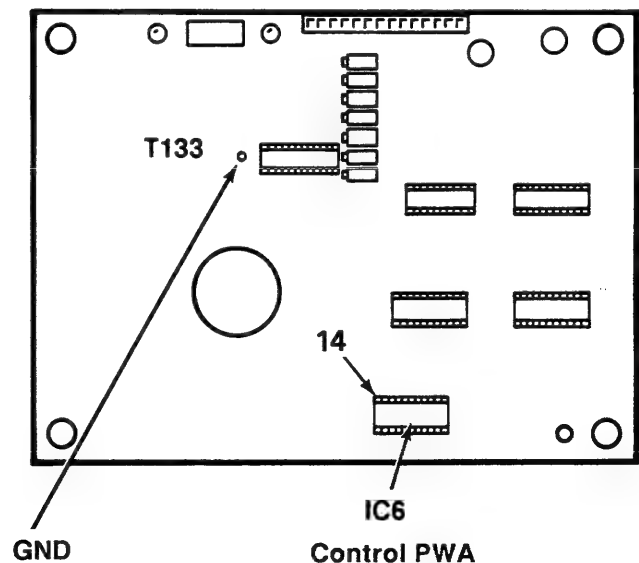


Figure 3-5A

Note

Connect a voltmeter between Control PWA TP133 and pin 14 of IC6.

9. Repeat Measurement Step 2 and 3.



3-6. ENCODER DISC

3-6.1. ENCODER DISC SENSOR VERTICAL POSITION (LED Method)

Specification

The Encoder Disc Sensor should be positioned vertically for consistent film movement when the Speed Control is moved off the "0" position.

Measurement/Adjustment

1. Switch OFF the Reader-Printer.
2. Disconnect the M-652 Wiring Harness.
3. Remove the Roll Film Transport.
4. Remove the Top Left Cover (Disassembly 4-2.2, page 4-1).
5. Reconnect the Wiring Harness.
6. Switch ON the Reader-Printer.
7. Load film and turn the Speed Control to 0 degrees.
8. Turn the Manual Scan Control clockwise. The Green LED on the Control PWA (Figure 3-6A) should go out while turning the Manual Scan Control and stay on when the Manual Scan Control is not turned. Turn the Adjustment Nut (Figure 3-6A) until this condition is met.
9. Turn the Film Speed Control clockwise until the Glass Flat just opens. The Red LED on the Control PWA (Figure 3-6.A) should steadily pulse. Readjust the Adjustment Nut until this condition is met.
10. Turn the Film Speed Control fully clockwise. The film should move at a constant rate.
11. Turn the Film Speed Control fully counter-clockwise. The film should move at a constant rate.

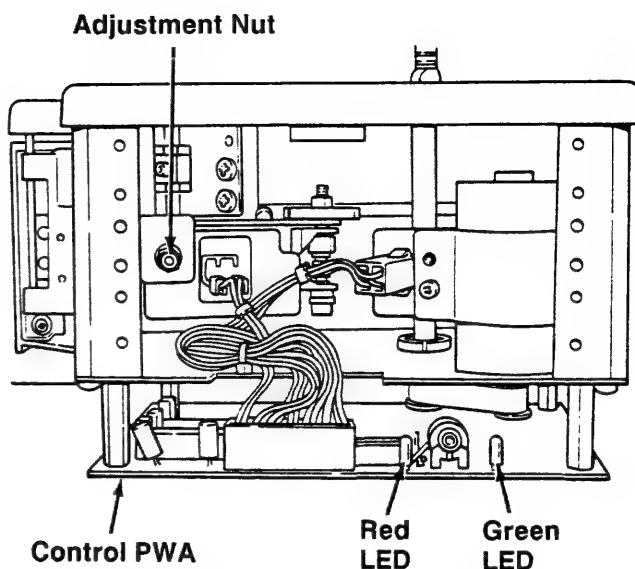


Figure 3-6A

3-6.2. ENCODER DISC SENSOR VERTICAL POSITION (Oscilloscope Method)

Specification

The Encoder Disc Sensor should be positioned vertically for consistent film movement when the Speed Control is moved off the "0" position.

Measurement/Adjustment

Note

Encoder Disc Horizontal Adjustment 3-6.3 should be done first.

1. Switch OFF the Reader-Printer.
2. Disconnect the M-652 Wiring Harness.
3. Remove the Roll Film Transport.
4. Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
5. Remove the Top Left Cover (Disassembly 4-2.2, page 4-1).
6. Remove the Control PWA but do not disconnect it (Disassembly 4-3.2, page 4-5).
7. Set the Oscilloscope Controls as shown in Figure 3-6.2A.

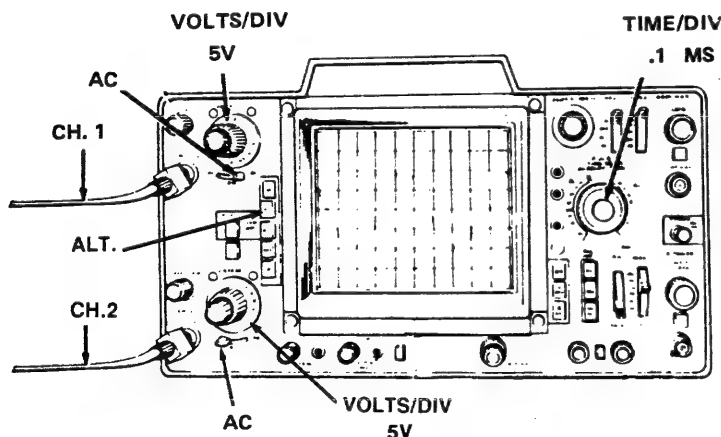


Figure 3-6.2A

8. Connect the Channel 1 Scope Probe to T1 on the Control PWA (Figure 3-6.2B).
9. Connect the Channel 2 Scope Probe to T21 on the Control PWA (Figure 3-6.2B).

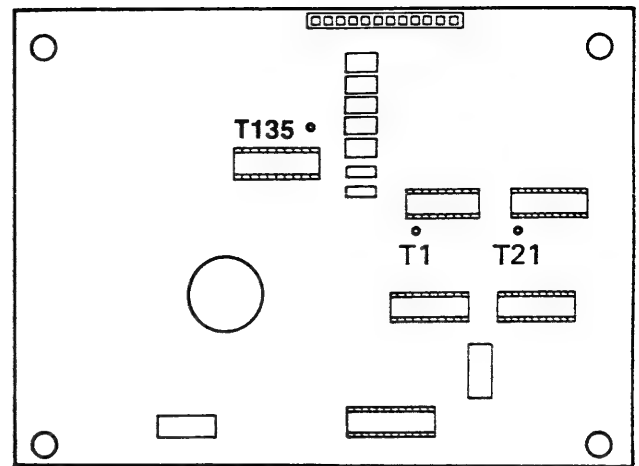


Figure 3-6.2B

10. Ground the Oscilloscope Ground Leads to T135 on the Control PWA (Figure 3-6.2B).
11. Reconnect the Roll Film Transport and switch ON the Reader-Printer.
12. Set the horizontal position of both channels so that Channel 1 is above Channel 2.
13. Load film and turn the Film Speed Control clockwise until the Glass Flat just opens. The Channel 1 waveform should lead the Channel 2 waveform by $90^\circ \pm 15^\circ$ (Figure 3-6.2C).

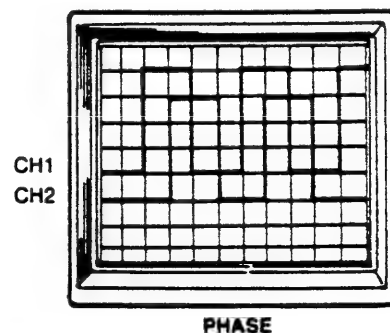


Figure 3-6.2C

Adjustment

1. Turn the Adjustment Nut (Figure 3-6A, pg 3-8) so the Channel 1 waveform leads the Channel 2 waveform by $90^\circ \pm 15^\circ$ (Figure 3-6. 2C).

3-6.3 ENCODER DISC HORIZONTAL POSITION

Specification

The Encoder Disc must be parallel with but not touching the Blip Sensor Slot. The measured voltage at T2 and T22 should be greater than 3 Vpp without clipping or distortion.

Special Tools

Inspection Mirror
Oscilloscope

Measurement

1. Switch OFF the Reader-Printer.
2. Disconnect the M-652 Wiring Harness.
3. Remove the Roll Film Transport.
4. Remove the Rear Cover (Disassembly 4-2.2, page 4-1).
5. Remove the Top Left Cover (Disassembly 4-2.2, page 4-1).
6. Remove the Control PWA but do not disconnect it (Disassembly 4-3.2, page 4-5).

Note

If T2 is near Pin 1 of N2, connect the Channel 1 Scope Probe to the end of R1 opposite Pin 1. (Figure 3-6.3B)

7. Connect the Channel 1 Scope Probe to T2 and the Channel 1 Ground to T135 on the Control PWA (Figure 3-6.3A).

Note

If T22 is near Pin 1 of N3, connect the Channel 2 Scope Probe to the end of R21 opposite Pin 1. (Figure 3-6.3B)

8. Connect the Channel 2 Scope Probe to T22 on the Control PWA (Figure 3-6.3A). Do not connect the Channel 2 ground.
9. Set the Oscilloscope Controls as shown in (Figure 3-6.3C).
10. Reconnect the Roll Film Transport and switch ON the Reader-Printer.
11. Load film and turn the Speed Control to 0 degrees.

Control PWA S/N 5201852 and above

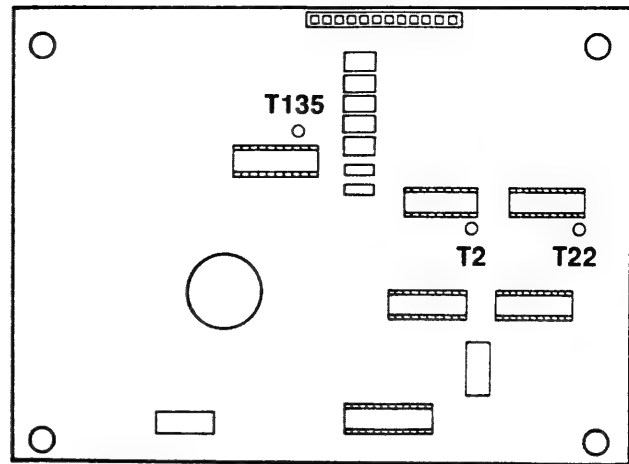


Figure 3-6.3A

Control PWA below S/N 5201852

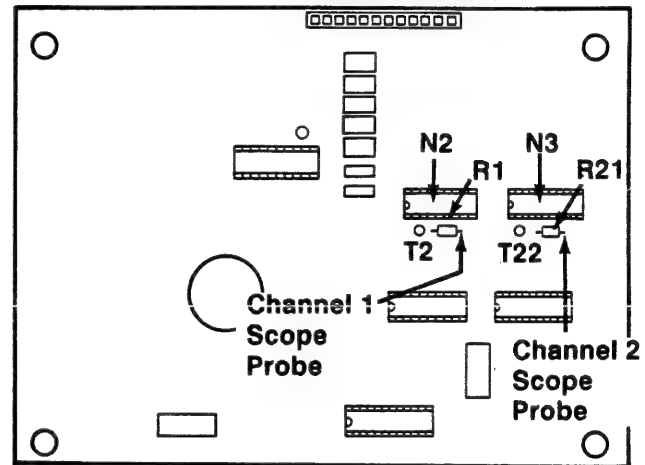


Figure 3-6.3B

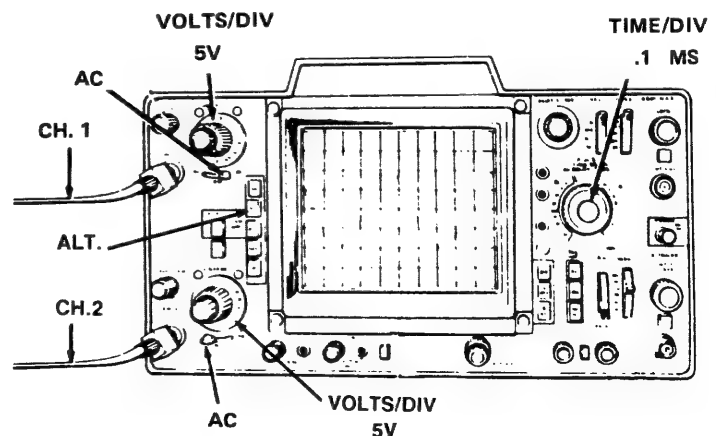


Figure 3-6.3C

12. Turn the Speed Control clockwise to advance film at a medium speed. Listen and ensure that the Encoder Disc is not rubbing the sensor (Figure 3-6.3D). The amplitude of the Channel 1 and Channel 2 displays should be greater than 3 Vpp without clipping or distortion (Figure 3-6.3E).
13. Return the Film Speed Control to 0 degrees and switch OFF the Reader-Printer.

Adjustment

1. Loosen the Locking Nut for the Amplitude Adjustment Screw and, while holding the Locking Nut, turn the Amplitude Adjustment Screw clockwise to increase the amplitude or counterclockwise to decrease clipping and distortion (Figure 3-6.3F).
2. Repeat Measurement Steps 10 through 13.

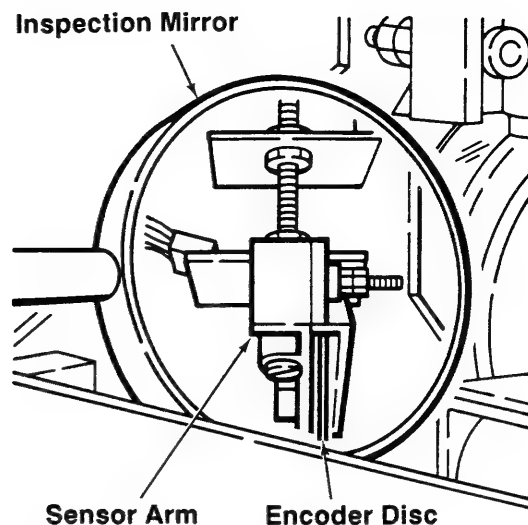


Figure 3-6.3D

CH1=CH2

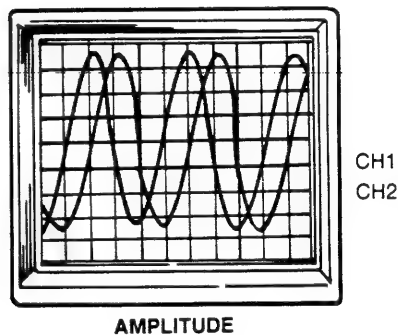


Figure 3-6.3E

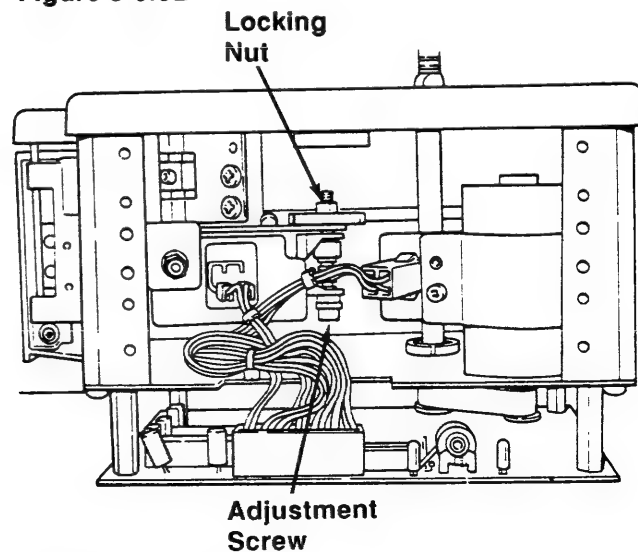


Figure 3-6.3F

3-7. FILM TRAVERSE

Specification

The Film Traverse must slide smoothly.

Measurement

1. Turn the Film Traverse Control clockwise. The Cabinet Assembly should move smoothly.
2. Turn the Film Traverse Control counter-clockwise. The Cabinet Assembly should move smoothly.

Adjustment

1. Switch OFF the Reader-Printer.
2. Disconnect the M-652 Wiring Harness.
3. Remove the Roll Film Transport.
4. Remove the Bottom Cover (Disassembly 4-2.6, page 4-4).
5. Loosen both Adjustment Screws (Figure 3-7A).
6. Press the Metal Bracket against the plastic support (Figure 3-7A) and tighten the Adjustment Screws. Add Lockwashers if the bracket loosens frequently.

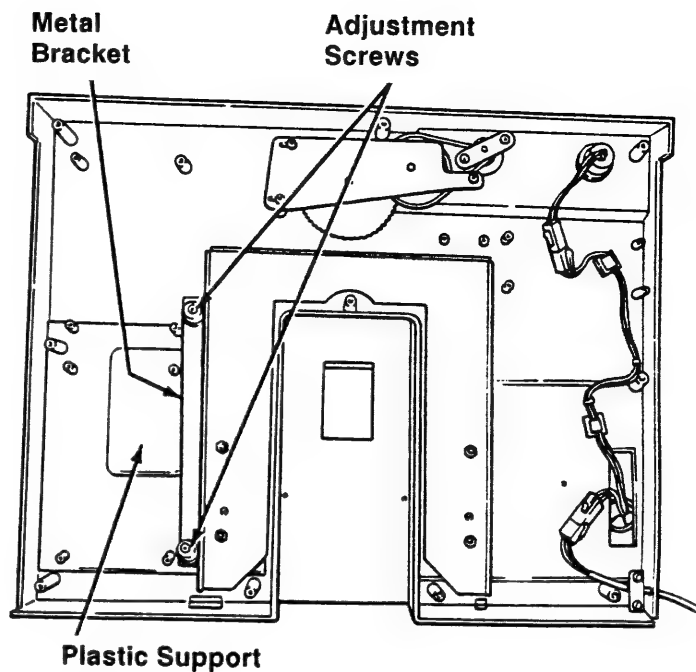


Figure 3-7A

3-8. FILM END SWITCH

Specifications

The Film Spool should not move when the film runs out.

The actuator of the Film End Switch must have 0.5 mm to 1.5 mm (0.02 in. to 0.05 in.) of free play with film loaded.

Special Tools

Ruler

Measurement

1. Switch ON the Reader-Printer.
2. Load film and turn the Speed Control clockwise. The film should move to the right.
3. Turn the Speed Control counterclockwise until the film runs out. The Take-Up Reel should stop.

Adjustments

1. Switch OFF the Reader-Printer.
2. Disconnect the M-652 Wiring Harness.
3. Remove the Roll Film Transport.
4. Remove the Top Right Cover (Disassembly 4-2.3, page 4-2).
5. Loosen the mounting screws securing the Film End Switch (Figure 3-8A).

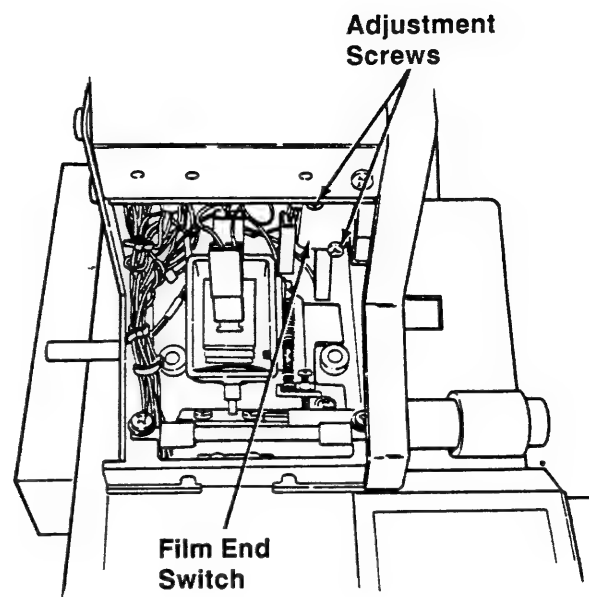


Figure 3-8A

6. Adjust the Film End Switch so that when actuated, the actuator has 0.5 mm to 1.5 mm (0.02 in. to 0.05 in.) of free play (the actuator should not bottom out) and tighten the screws.
7. Repeat Measurement Steps 2 and 3.

3-9. FILM GUIDE ROLLERS

Specification

Film should move between the Upper and Lower Glass Flats without touching during fast or slow film scanning.

The gap between taut film and the Upper Glass Flat should be 0.0015 in. (0.04 mm).

Special Tools

Feeler Gauge

Measurement

1. Load and advance film.
2. Remove the Lower Glass Flat (M-652 Operating Instructions).
3. Insert a 0.0015 in. (0.04 mm) Feeler Gauge between the Upper Glass Flat and top of the film. The Viewing Screen of the Reader-Printer should display the shadow of the Feeler Gauge adjacent to an image.
4. While pressing the film against the Feeler Gauge, focus an image.
5. Remove the Feeler Gauge. The Image should remain in focus. You may need to pull the film taut by holding the Film Reel and turning the Manual Scan Control clockwise.

Note

With the Reader-Printer Projection Lamp on, sight between the film and the Upper Glass Flat. You should see a gap.

Adjustment

1. Switch OFF the Reader-Printer.
2. Disconnect the M-652 Wiring Harness.
3. Remove the Roll Film Transport.
4. Remove the Rear Cover (Disassembly 4-2.1, page 4-1).

5. Remove the Top Left Cover Disassembly 4-2.2, page 4-1) and the Top Right Cover (Disassembly 4-2.3, page 4-2).
6. Remove the Front Left Cover (Disassembly 4-2.4, page 4-3) and the Front Right Cover (Disassembly 4-2.5, page 4-4).
7. Reinstall the Roll Film Transport and connect the Wiring Harness.
8. Switch ON the Reader-Printer.
9. Loosen the Locknut and turn the Adjustment Screw for the Left Film Roller clockwise to lower the film and counterclockwise to raise the film as required (Figure 3-9A).

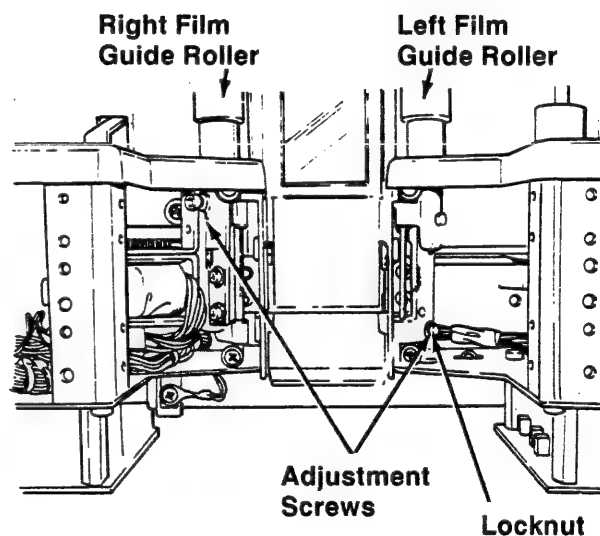


Figure 3-9A

10. Turn the Adjustment Screw for the Right Film Roller counterclockwise to raise the film and counterclockwise to lower the film as required (Figure 3-9A).
11. Repeat Measurement Steps 3 through 5.

-
12. Apply a dab of Loctite to the threads of the Adjustment Screws.

Note

The Roll Film Transport is shipped with clear 6.5 mil tape (78-8003-4753-2) applied to the Lower Glass Flat for 5 to 6.4 mil film. Remove this tape and apply blue 5 mil tape (78-8003-4752-4) for 3.5 to 4.9 mil film or white 3.5 mil tape (78-8003-4751-6) for 2 to 3.4 mil film.

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4-1. GENERAL

The disassembly procedures in this section are illustrated views with a minimum of supporting text. The order of disassembly is indicated numerically with 1 being the first step 2 the second step, etc. Assembly is in the reverse order of disassembly.

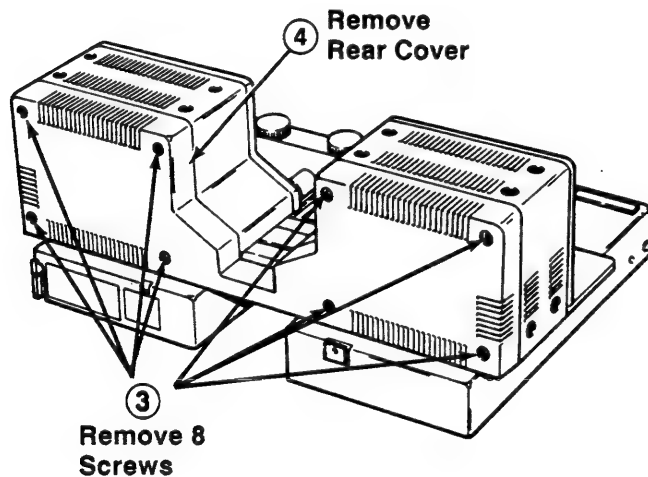
Review and understand each procedure carefully before disassembly of any component.

4-2. EXTERNAL COVERS

4-2.1. REAR COVER

WARNING
SWITCH OFF THE READER-PRINTER.

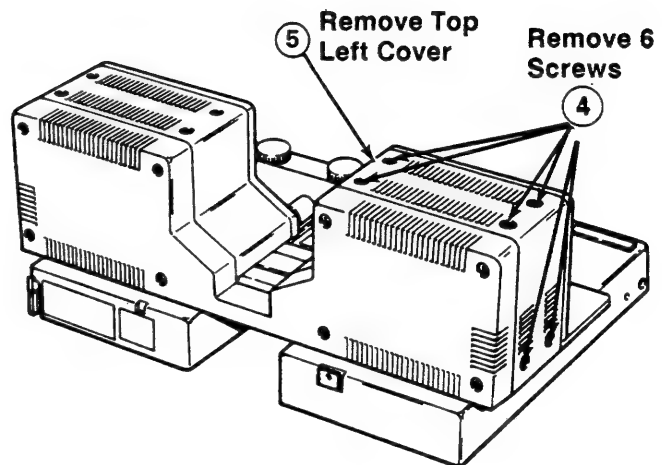
- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.



4-2.2. TOP LEFT COVER

WARNING
SWITCH OFF THE READER-PRINTER.

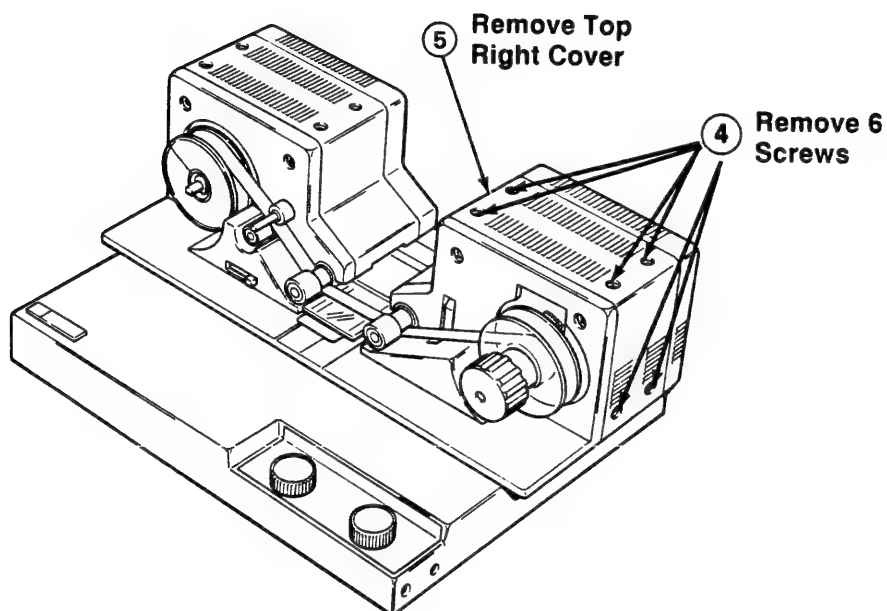
- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).



4-2.3. TOP RIGHT COVER

WARNING
SWITCH OFF THE READER-PRINTER.

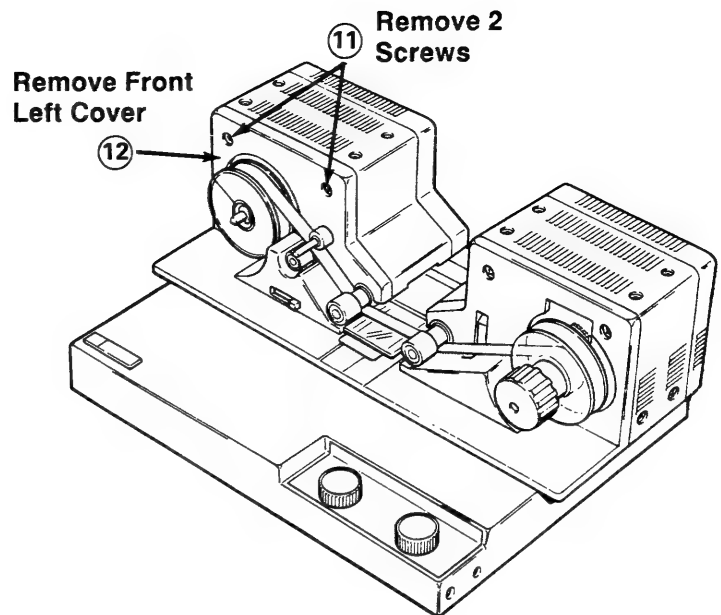
- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).



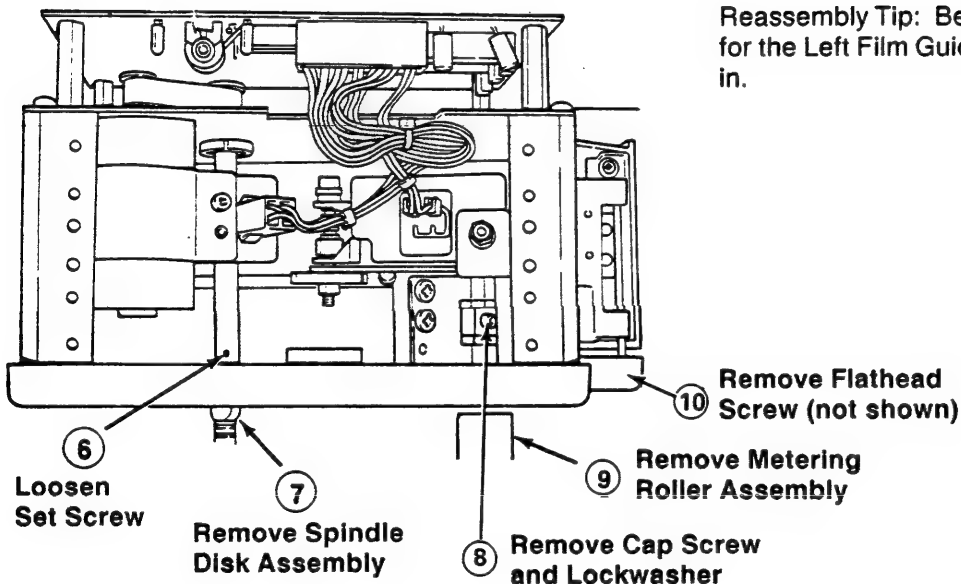
4-2.4. FRONT LEFT COVER

WARNING
SWITCH OFF THE READER-PRINTER AND
UNPLUG THE POWER CORD.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
- ④ Remove the Top Left Cover (Disassembly 4-2.2, page 4-1).
- ⑤ Remove the Left Film Guide Roller (Disassembly 4-4.5, page 4-12).



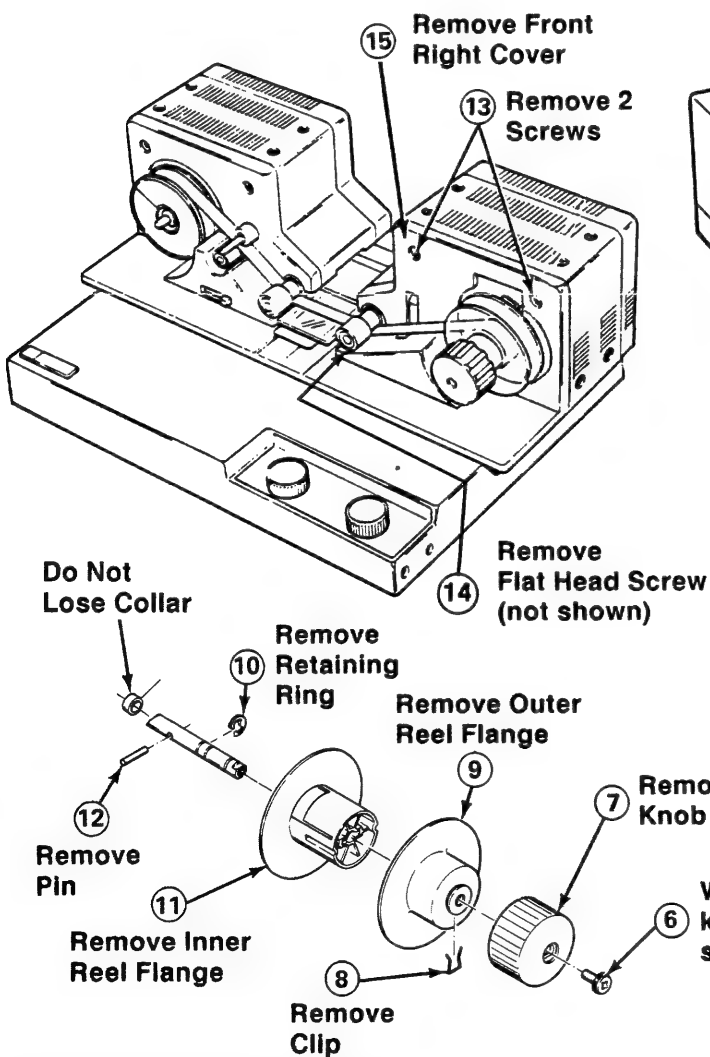
Reassembly Tip: Be sure to push the shaft for the Left Film Guide Roller all the way in.



4-2.5. FRONT RIGHT COVER

WARNING
SWITCH OFF THE READER-PRINTER AND
UNPLUG THE POWER CORD.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
- ④ Remove the Top Right Cover (Disassembly 4-2.3, page 4-2).
- ⑤ Remove the Right Film Guide Roller (Disassembly 4-4.5, page 4-12).

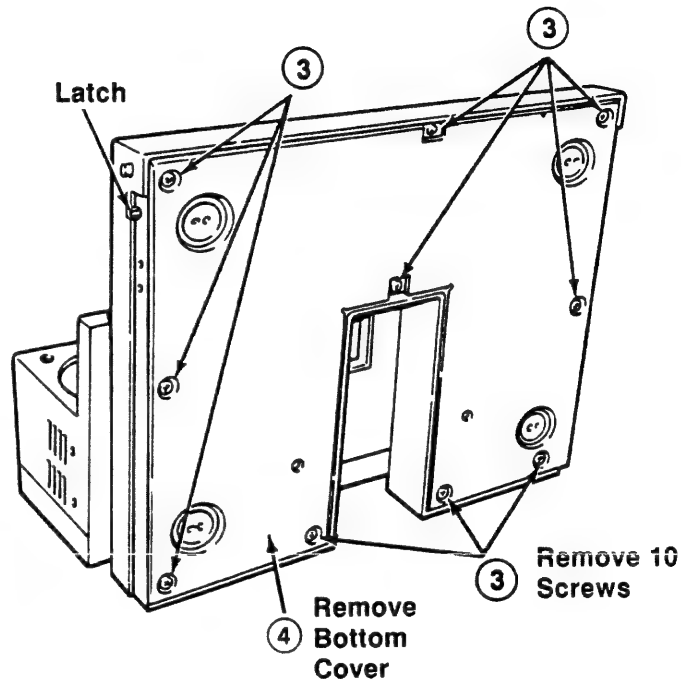


Reassembly Tip: Lift the Sensor Arm and guide it through the hole in the Cover.

4-2.6. BOTTOM COVER

WARNING
SWITCH OFF THE READER-PRINTER AND
UNPLUG THE POWER CORD.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.



Reassembly Tip: Push in on the Latches while pushing in the Cover.

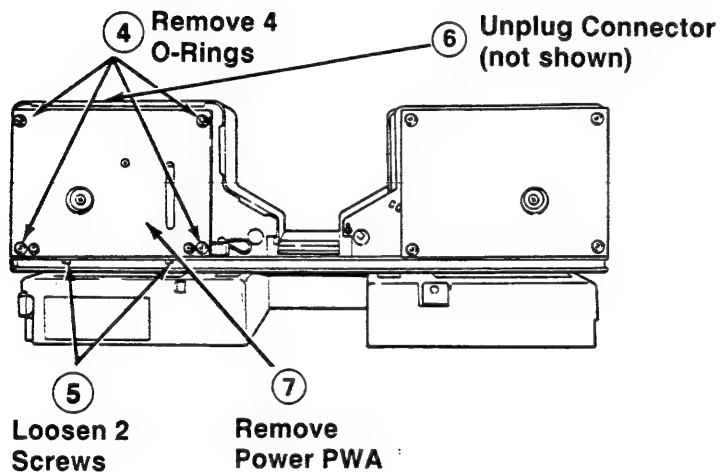
4-3. ELECTRICAL COMPONENTS

4-3.1. POWER PWA

WARNING
SWITCH OFF THE READER-PRINTER.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).

CAUTION
Use Static Wrist Strap.

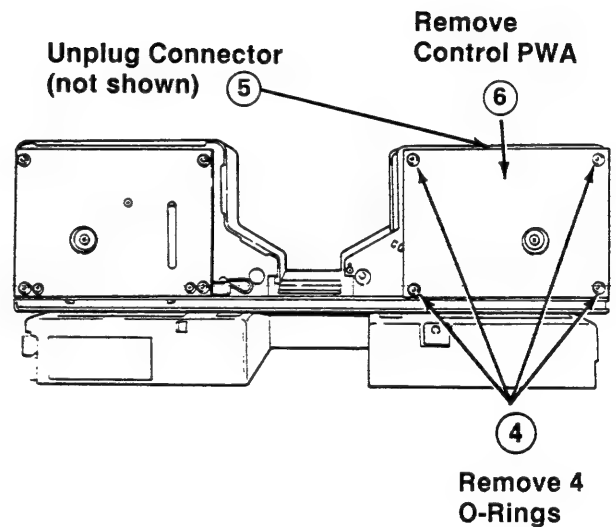


4-3.2. CONTROL PWA

WARNING
SWITCH OFF THE READER-PRINTER.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).

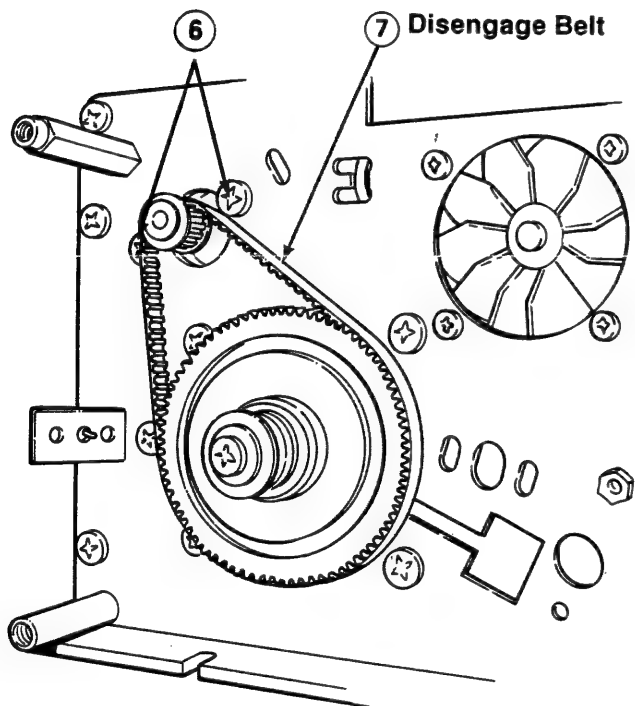
CAUTION
Use Static Wrist Strap.



4-3.3. FILM FORWARD MOTOR

WARNING
 SWITCH OFF THE READER-PRINTER AND
 UNPLUG THE POWER CORD.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
- ④ Remove the Top Right Cover (Disassembly 4-2.3, page 4-2).
- ⑤ Remove the Power PWA (Disassembly 4-3.1, page 4-5).



- ⑧ Remove Film Forward Motor (not shown).
- ⑨ Unplug Connector (not shown).

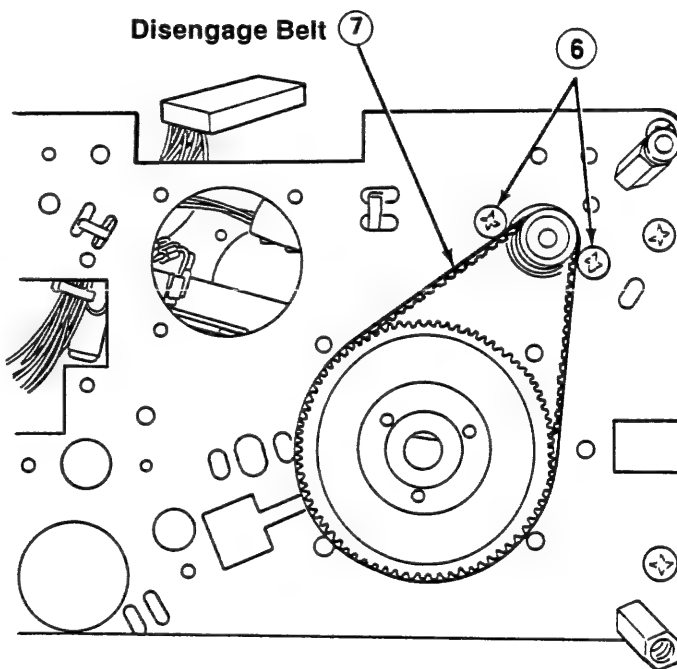
Note

After reassembly, do Film Forward Motor Drive Belt Adjustment 3-3.1, page 3-4.

4-3.4. FILM REVERSE MOTOR

WARNING
 SWITCH OFF THE READER-PRINTER AND
 UNPLUG THE POWER CORD.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
- ④ Remove the Top Left Cover (Disassembly 4-2.2, page 4-1).
- ⑤ Remove the Control PWA (Disassembly 4-3.2, page 4-5).



- ⑧ Remove Film Reverse Motor (not shown).
- ⑨ Unplug Connector (not shown).

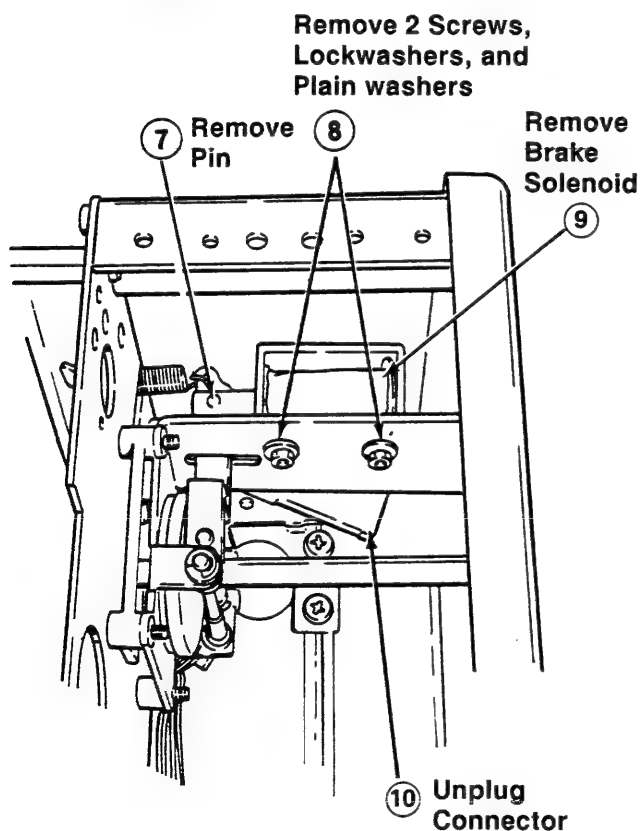
Note

After reassembly, do Film Reverse Motor Drive Belt Adjustment 3-3.2, page 3-5.

4-3.5. BRAKE SOLENOID

WARNING
SWITCH OFF THE READER-PRINTER AND
UNPLUG THE POWER CORD.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
- ④ Remove the Top Right Cover (Disassembly 4-2.3, page 4-2).
- ⑤ Remove the Power PWA (Disassembly 4-3.1, page 4-5).
- ⑥ Remove the Film Forward Motor (Disassembly 4-3.3, page 4-6).

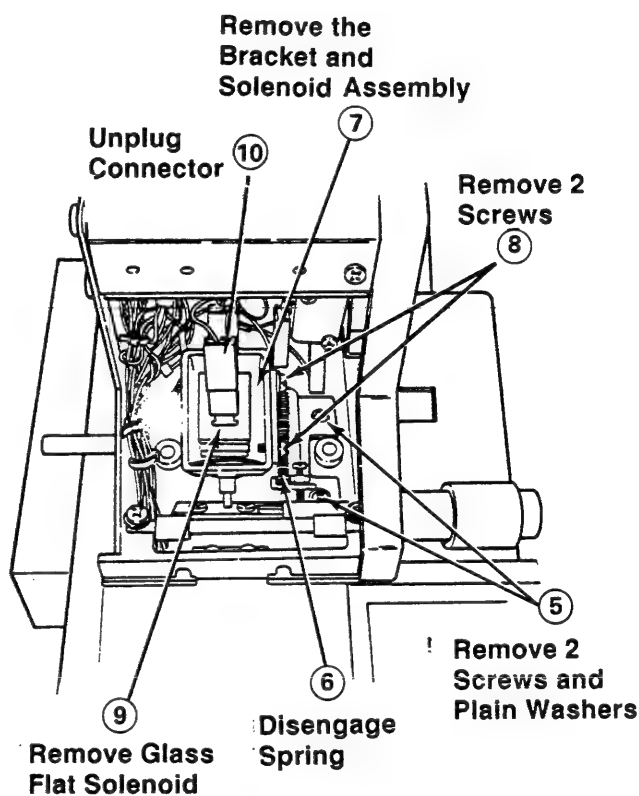
**Note**

After reassembly, do Brake Solenoid and Brake Disc Adjustment 3-2, page 3-2 and Film Forward Motor Drive Belt Adjustment 3-3.1, page 3-4.

4-3.6. GLASS FLAT SOLENOID

WARNING
SWITCH OFF THE READER-PRINTER AND
UNPLUG THE POWER CORD.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
- ④ Remove the Top Right Cover (Disassembly 4-2.3, page 4-2).

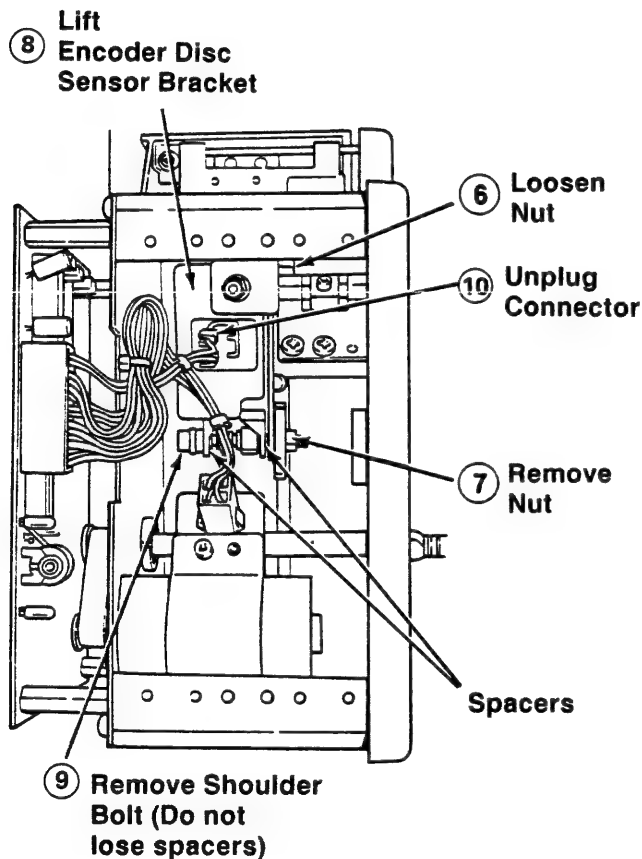
**Note**

After reassembly, do the Lower Glass Flat Solenoid Adjustment 3-1, page 3-1.

4-3.7. ENCODER DISC SENSOR

WARNING
SWITCH OFF THE READER-PRINTER AND
UNPLUG THE POWER CORD.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
- ④ Remove the Top Left Cover (Disassembly 4-2.2, page 4-1).
- ⑤ Remove the Control PWA (Disassembly 4-3.2, page 4-5).



Reassembly Tip: Do not over tighten Nut loosened in Step 6.

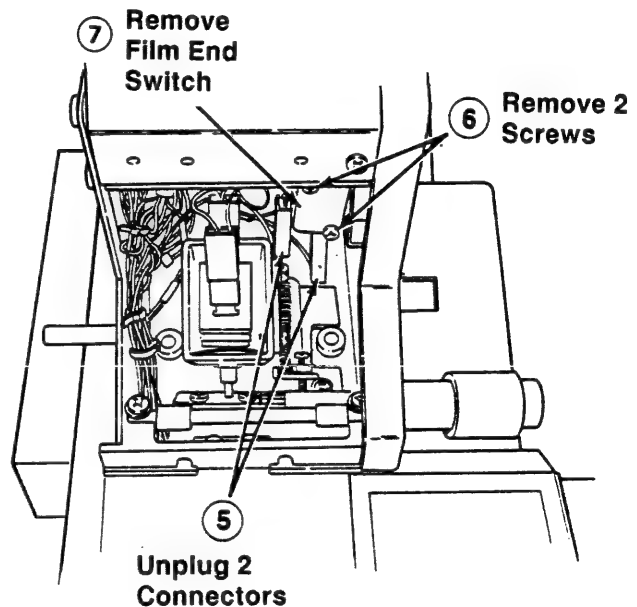
Note

After reassembly, do the Encoder Disc Sensor Vertical Position Adjustment 3-6.1, page 3-8 or 3-6.2, page 3-9 and Encoder Disc Horizontal Position Adjustment 3-6.3, page 3-10.

4-3.8. FILM-END SWITCH

WARNING
SWITCH OFF THE READER-PRINTER AND
UNPLUG THE POWER CORD.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
- ④ Remove the Top Right Cover (Disassembly 4-2.3, page 4-2).

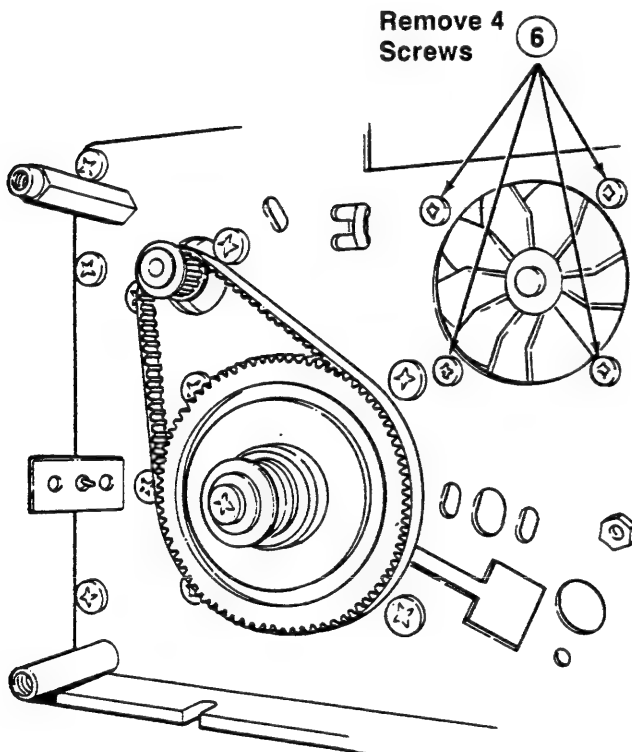
**Note**

After reassembly, do the Film End Switch Adjustment 3-8, page 3-12.

4-3.9. BLOWER ASSEMBLY

WARNING
SWITCH OFF THE READER-PRINTER AND
UNPLUG THE POWER CORD.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
- ④ Remove the Top Right Cover (Disassembly 4-2.3, page 4-2).
- ⑤ Remove the Power PWA (Disassembly 4-3.1, page 4-5).



- ⑦ Remove the Blower Assembly (not shown).
- ⑧ Unplug Connector (not shown).

4-4. MISCELLANEOUS COMPONENTS

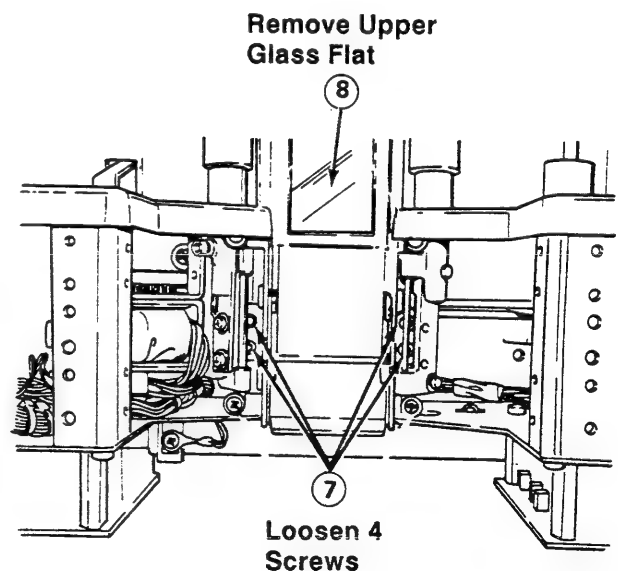
4-4.1. UPPER GLASS FLAT

Note

Removal of the Upper Glass Flat is not recommended because of potential damage to tape spacers.

WARNING
SWITCH OFF THE READER-PRINTER AND
UNPLUG THE POWER CORD.

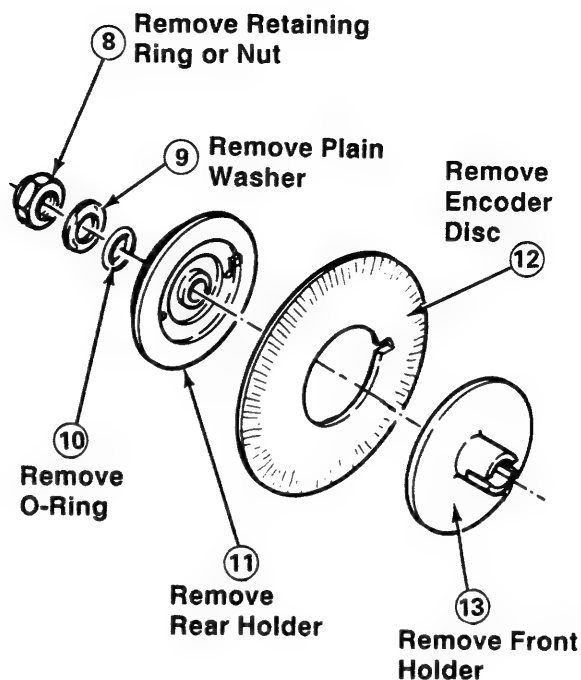
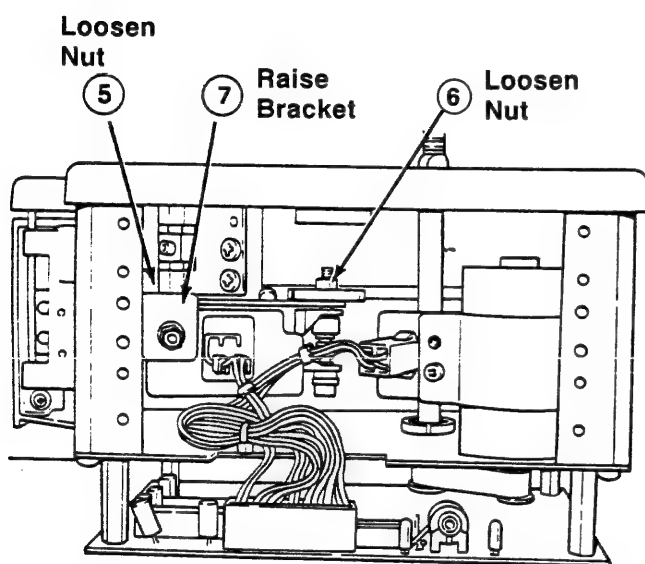
- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
- ④ Remove the Top Left Cover (Disassembly 4-2.2, page 4-1).
- ⑤ Remove the Top Right Cover (Disassembly 4-2.3, page 4-2).
- ⑥ Remove the Lower Glass Flat.



4-4.2. ENCODER DISC

WARNING
SWITCH OFF THE READER-PRINTER AND
UNPLUG THE POWER CORD.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
- ④ Remove the Top Left Cover (Disassembly 4-2.2, page 4-1).



Reassembly Tip: Position Pin in Front Holder with slot in Encoder Disk (unpolished side toward nut) then with hole in Rear Holder.

Note

After reassembly, do the Encoder Disc Sensor Vertical Position Adjustment 3-6.1, page 3-8 or 3-6.2, page 3-9 and Encoder Disc Horizontal Position Adjustment 3-6.3, page 3-10.

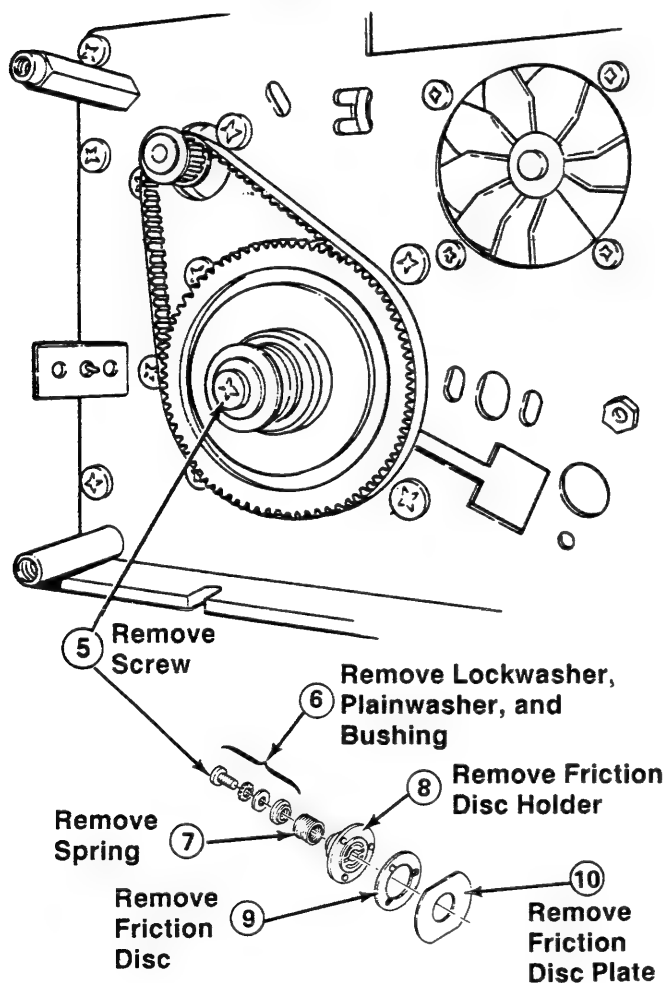
Reassembly Tip: Position pin in Front Holder with slot in Encoder Disk then with hole in Rear Holder.

4-4.3. OVERLOAD CLUTCH FRICTION DISC

WARNING
SWITCH OFF THE READER-PRINTER AND
UNPLUG THE POWER CORD.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
- ④ Remove the Power PWA (Disassembly 4-3.1, page 4-5).

CAUTION
Do not lose the Shaft Pin.



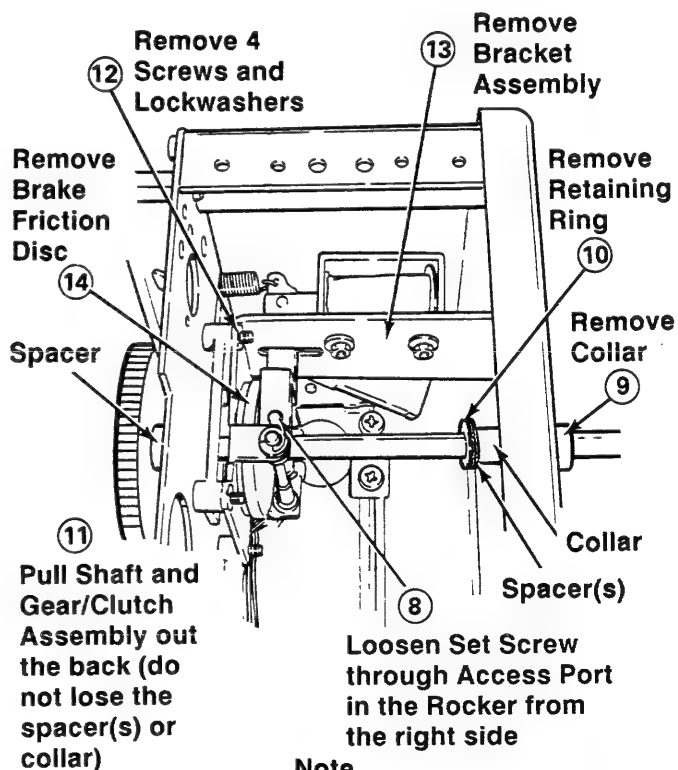
Reassembly Tip: The flats of the Friction Disc Plate should fit within the flats of the Gear.

Note
After reassembly, do the Overload Clutch Reference only Friction Disc Plate Adjustment 3-4, page 3-6.

4-4.4. BRAKE FRICTION DISC

WARNING
SWITCH OFF THE READER-PRINTER AND
UNPLUG THE POWER CORD.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
- ④ Remove the Top Right Cover (Disassembly 4-2.3, page 4-2).
- ⑤ Remove the Power PWA (Disassembly 4-3.1, page 4-5).
- ⑥ Remove the Film Advance Motor (Disassembly 4-3.3, page 4-6).
- ⑦ Do up to Step 12 of Front Right Cover (Disassembly 4-2.5, page 4-4).



Note
After reassembly, do the Brake Solenoid and Brake Disc Adjustment 3-2, page 3-2, Film Forward Motor Drive Belt Adjustment 3-3.1, page 3-4, and Overload Clutch Adjustment 3-4, page 3-6.

4-4.5. GUIDE ROLLERS

WARNING

SWITCH OFF THE READER-PRINTER AND UNPLUG THE POWER CORD.

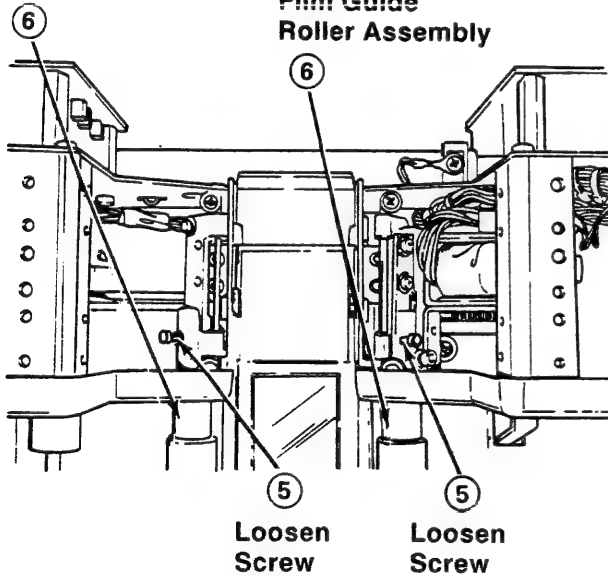
- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
- ④ Remove the Top Left Cover (Disassembly 4-2.2, page 4-1), or Remove the Top Right Cover (Disassembly 4-2.3, page 4-2).

Note

Do not lose the Bushing or Spacer for either Film Guide Roller.

**Remove Left
Film Guide
Roller Assembly**

**Remove Right
Film Guide
Roller Assembly**



**Loosen
Screw**

**Loosen
Screw**

Reassembly Tip: Be sure to push the shaft of the Film Guide Rollers all the way in.

Note

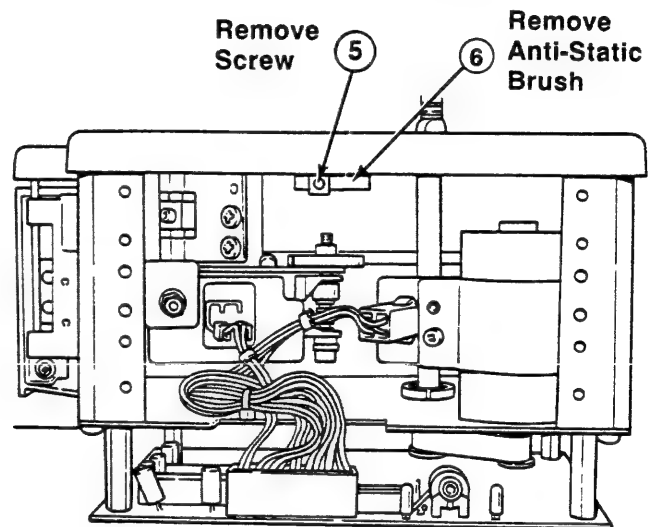
After reassembly, do the Film Guide Roller Adjustment 3-9, page 3-13.

4-4.6. ANTI-STATIC BRUSH

WARNING

SWITCH OFF THE READER-PRINTER AND UNPLUG THE POWER CORD.

- ① Disconnect the Roll Film Transport.
- ② Remove the Roll Film Transport.
- ③ Remove the Rear Cover (Disassembly 4-2.1, page 4-1).
- ④ Remove the Top Left Cover (Disassembly 4-2.2, page 4-1).



**Remove
Screw**

**Remove
Anti-Static
Brush**

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5-1. CLEANING**Machine**

Gently wipe the machine with a clean cloth dampened with alcohol.

Glass Flats

1. Remove film from the machine (See 110 RFT Operating Instructions).
2. Pull the Lower Glass Flat straight towards you.
3. Clean both sides of the lower Glass Flat and the Upper Glass Flat with any commercial lens cleaner and a soft, clean cloth or tissue.

CAUTION

DO NOT REMOVE THE UPPER GLASS FLAT. Improper installation will cause focus problems.

4. Position the lower Glass Flat and push straight back until both pins engage.
5. Turn the Film Speed Control to 0 degrees.

5-2. FILM STORAGE AND HANDLING

Refer to Basic Micrographics Training

5-3. PEM CHECKLIST

Section	Item to Check	Every Call	Each 10K	Each 20K	Replace Every	Remarks
External	Overall Unit	CH				
	Glass Flats		CL			
	Tape Strips				100K	
Internal	Brake Disc and Solenoid	CH				
	Window Solenoid	CH				
	Drive Belts	CH				
	Overload Clutch	CH				
	Film End Switch	CH				
	Rollers			CL		
	Counter O-Ring		CH			

Notes: CH - Check in Operation

CL - Clean, see Cleaning Chart

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6-2.	Component Description	6-1
6-3.	Theory of Operation	6-4

6-1. DESCRIPTION

The M-652 (110 RFT) is a motor driven 16 mm and 35 mm film transport. It is used as an option on the M-7530 (MFB 1100) and M-7540 for viewing negative or positive microfilm images and printing positive 8 1/2" by 11" or A4 size copies.

The M-652 transports film from a film spool spindle via guide rollers between two glass flats onto a take-up reel. The film width is accommodated by removing and reversing the guide rollers and pushing in the front flange of the take-up reel for 16 mm film or pulling out the front flange for 35 mm film. The operator can easily load or remove film.

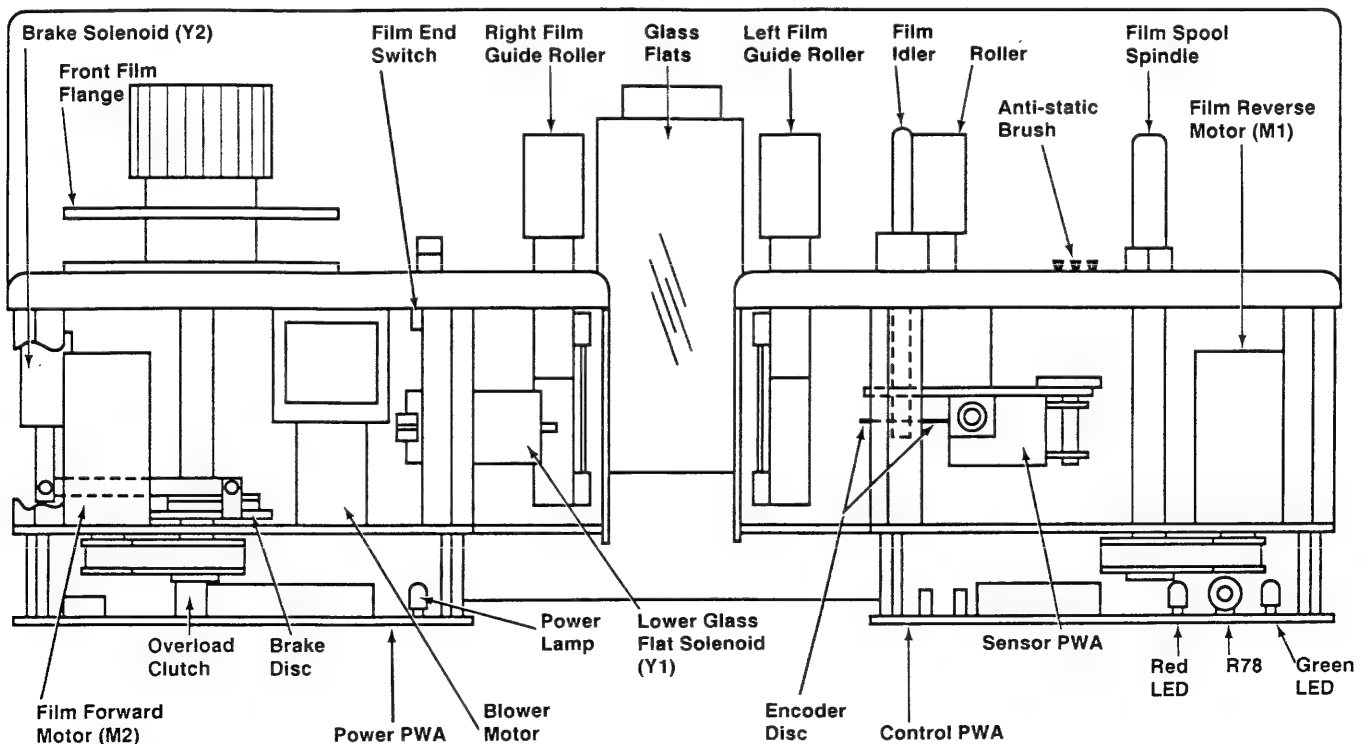
The operator can slowly or quickly advance or reverse film and hold an individual frame for viewing or printing. An operator controlled film speed control determines which of two motors will run and at what speed. To avoid damaging the film during fast forward or fast

reverse speeds, the lower glass flat and right guide roller are automatically lowered when a certain film speed is reached. A film-end switch shuts off the film drive system as the film runs out or breaks. The motor speed is electronically controlled by an optical switch and encoder disc driven by the film.

A film odometer can assist the operator in locating specific film frames. The operator can manually search images also. The film is held in constant tension by an electrical torque balance of both motors.

A manual film traverse control moves the image of the film frame up or down for better location on the Viewing Screen. The machine will automatically shut off at the end of the film or if the film breaks. The operator can easily remove the M-652 and exchange it for another form of microfiche handler.

6-2. COMPONENT DESCRIPTION



Anti-Static Brush--Conductive brush fibers rub against the film spool as it turns to prevent a static charge from forming.

Blower Motor--Cools the Power PWA. Runs continuously on rectified + 25 vdc through an Oscillator that produces an alternating current. No longer included with machines after S/N 5201101.

Brake Disc--Presses against a Metal Disc by spring pressure when the Brake Disc Solenoid (Y1) is deactuated. Prevents film from moving when the Film Speed Control is at "0". See Adjustment 3-2. Brake Solenoid and Brake Disc, page 3-2.

Brake Solenoid (Y2)--Releases a spring actuated brake to allow film movement. When deactuated, the Brake Disc is allowed to press against a Metal Disc to prevent film from moving when the Film Speed Control is at "0". Protected by Thermal Fuse F4. See Adjustment 3-2. Brake Solenoid and Brake Disc, page 3-2.

Control PWA--Controls film speed and direction through a film speed detection circuit.

Encoder Disc--Consists of a photoelectric encoder in which the reading head consists of two light sources on one side of the disc and corresponding light sensors facing it on the other side of the disc. The coded pattern is evenly spaced, partly translucent, partly opaque. As the disc turns, the pattern acts as an on/off switch to produce a digital signal. The faster the disc turns, the faster the pulse generated. Measures the amount of film movement and direction. See Adjustment 3-6.1 Encoder Disc Sensor Vertical Position (LED Method), page 3-8; 3-6.2 Encoder Disc Sensor Vertical Position (Oscilloscope Method), page 3-9; and, 3-6.3 Encoder Disc Horizontal Position, page 3-10.

Film End Switch--Deactuates as film runs out or breaks to shut off the M-652.

Film Forward Motor (M2)--Drives film forward when the Film Speed Control is turned clockwise from "0". Protected by Thermal Fuse F2. See Adjustment 3-3.2 Film Reverse Motor Drive Belt, page 3-5.

Film Guide Rollers--Guide film during film scanning and holds the film off the surface of the glass flats to minimize the possibility of film scratching during scanning operations. Reversible for 35 mm film or 16 mm film.

Film Idler--Keeps film in the Film Guide Roller and drives off the Film Odometer Roller.

Film Odometer--Mechanical counter to help relocate specific frames of film. One hundred feet of film equals 2,360 digits.

Film Odometer Reset--Mechanical reset to bring Film Odometer back to 0000.

Film Reverse Motor (M1)--Rewinds film when the Film Speed Control is turned counter-clockwise from "0". Protected by Thermal Fuse (F1). See Adjustment 3-3.2 Film Reverse Motor Drive Belt, page 3-4.

Film Speed Control--Potentiometer used to move film forward or reverse at variable speeds. The maximum film speed is 10 ft/sec. The minimum slow moving film speed is 0.2 in/sec. No film movement when the Film Speed Control is at "0".

Film Spool Spindle--Accepts Film Spools up to 221 ft of 2.5 mil Diazo, Dry Diazo, Vesicular, or Silver Halide Film having a width of 16 mm or 35 mm. Accepts 100 ft. of 5 mil. film.

Front Film Flange--Pulls out for 35 mm film or pushes in for 16 mm film.

Glass Flats--Upper Glass Flat is stationary and Lower Glass Flat is movable. The Lower Glass Flat drops to allow film movement without scratching and clamps to flatten film for viewing or printing.

Green LED--Located on the Control PWA, it should go out while turning the Manual Scan Control and stay on when the Manual Scan Control is not turned. See Adjustment 3-6.1 Encoder Disc Sensor Vertical Position (LED Method), page 3-8.

Lower Glass Flat Solenoid (Y1)--Actuates the opening and closing of the glass flats. The Lower Glass Flat moves down when film is moved at a medium speed to prevent film and glass from scratching. The Lower Glass Flat moves up when film is moved at a slow speed or film is stationary to flatten the film for viewing or printing. Protected by Thermal Fuse F3. Also moves down when power is removed.

Overload Clutch--Mechanical clutch to prevent film from breaking. A Friction Disc is pushed against a Friction Disc Plate by Spring Force. See Adjustment 3-4 Overload Clutch Friction Disc, page 3-6.

Photosensors--Sense film movement.

Power Lamp--When lit, indicates power to Control PWA and Solenoids, is on.

Power PWA--Rectifies and filters the incoming 27 VAC from a secondary of the M-7530/7540 Main Transformer to provide three outputs:

- + 24 vdc to two LEDs, the Sensor PWA, and the Control PWA.
- Rectified + 25 vdc to the Blower Motor (M3).
- + 25 vdc to the Glass Flat Solenoid (Y1), Brake Solenoid (Y2), Film Reverse Motor (M1), and Film Forward Motor (M2).

A 5 Amp Fuse in the Reader-Printer and a 4 Amp Fuse on the Power PWA protects the Power PWA from excessive current.

R78 Adjusts the Film Speed Control for no film movement when the Film Speed Control is set to "0". See Adjustment 3-5 Film Speed Control, page 3-7.

Red LED--Located on the Control PWA, lights when power is available. It is part of the motor speed control circuit and blinks as each line of an Encoder Disc, driven by the film, passes a Photosensor. Should steadily pulse when the Film Speed control is turned clockwise far enough that the Lower Glass Flat drops. See Adjustment 3-6.1 Encoder Disc Sensor Vertical Position (LED Method), page 3-8.

Sensor PWA--Contains two Photosensors used to sense film movement. The Photosensors monitor film speed through an encoder disc that is part of the Odometer. One of the photosensors controls the speed of the Film Forward Motor (M2) and the other controls the speed of the Film Reverse Motor (M1). Direction is determined by which sensor senses blip first.

Thermal Fuses--Protects the Film Reverse Motor (M1), Film Forward Motor (M2), Glass Flat Solenoid, and Brake Solenoid from overloading.

6-3. THEORY OF OPERATION

As the Film Speed Control is turned slightly clockwise from the "0" position, the Film Forward Motor (M2) receives wide pulses determining its slow speed. If the speed control is turned slightly counterclockwise from the "0" position, similar wide pulses are sent to the Film Reverse Motor (M2) to rewind film.

An Encoder Disc, driven by the film, rotates either clockwise or counterclockwise and a slotted optical switch registers the change between light and dark areas on the disc. The speed of the Encoder Disc therefore determines the length of the pulses. An IC compares the rated pulse with the actual pulse and alters the pulse to the motor through a power transistor. Should the motor run faster, the pulses become wider; and conversely, should the motor run slower, the pulses become narrower. The motor not running functions as a generator to create pulses which limit the current of the machine.

A rotating brake disc, stationary contact plate, and a solenoid make up the film braking mechanism. When the speed control is turned to the "0" position, the solenoid de-energizes allowing the brake disc to be pulled against the contact plate by a spring.

The solenoids and drive motors all have Thermal Fuses in their circuits. A red LED on the Power PWA is lit as long as there is continuity through the fuses. If either fuse opens, the Power On Relay contact opens removing power from the the LED, Brake Solenoid, and film drive motors. The Blower Motor (M3) will continue to run to provide cooling.

At rest, the voltages at TP91 and TP92 are both about 0.85 vdc. When forward film scan is started, the voltage at TP91 initially drops, then rises to about 0.6 vdc as the speed stabilizes. The TP92 value starts high, and drops to about 1 vdc. When reverse film scan is begun, the signals at the Test Points are reversed.

Film tension is held constant by an electrical torque balance between the two drive motors.

The M-652 receives 27 VAC from a secondary transformer of the M-7530/40 Main Transformer. The voltage is routed through a port in the side of the machine to the Power PWA. A 5 amp fuse in the M-7530/40 protects this line before it reaches the Power PWA. A 4 amp fuse on the Power PWA protects the M-652 from excessive current.

The Power PWA rectifies and filters 24 vdc to the Control PWA, 25 vdc to the Blower and 25 vdc to the solenoids and film drive motors. The 25 vdc is an approximate no-load voltage which will vary as the load varies. The 24 vdc goes to the Control PWA and the Sensor PWA.

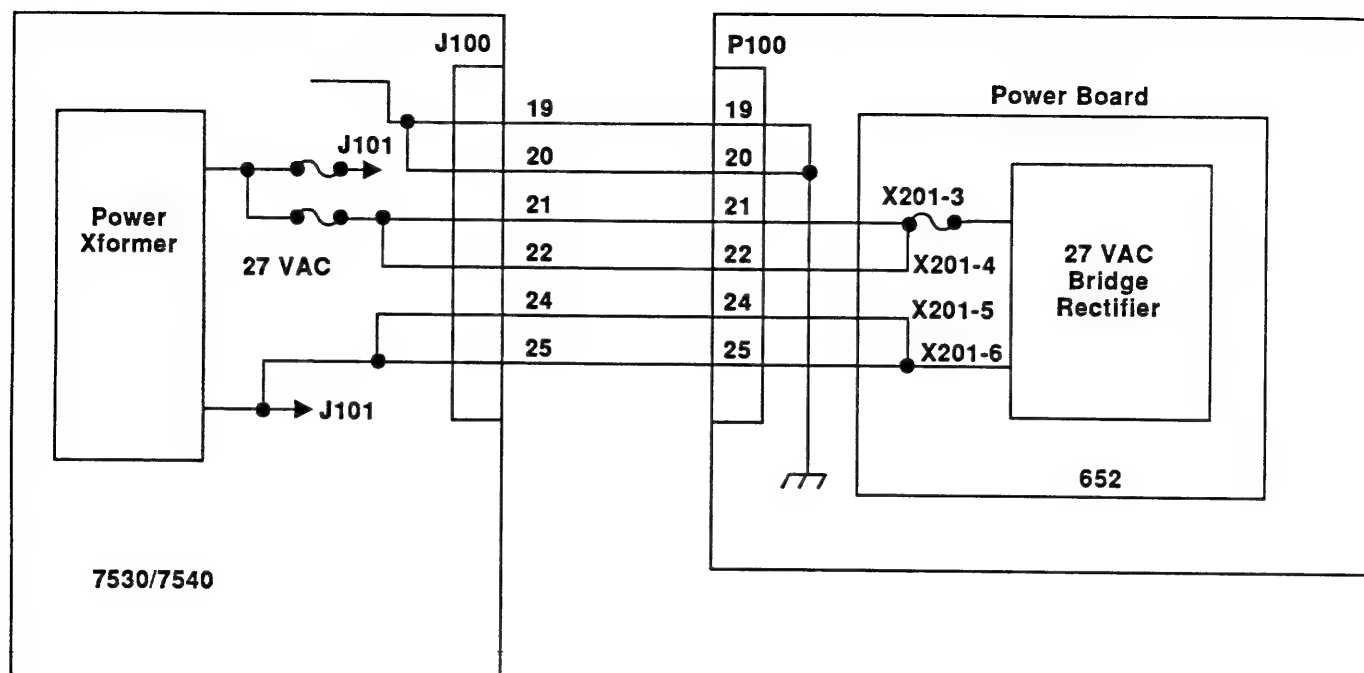
The 24 vdc on the Control PWA goes to a green LED and a red LED. The red LED is part of the motor speed control circuit and blinks as each line of an encoder disc driven by the film passes a photosensor, (visual detection can only be detected at very low film speeds).

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* Located in the binder pocket.

7-3. SYSTEM BLOCK DIAGRAM



* 7-4. AC POWER DISTRIBUTION

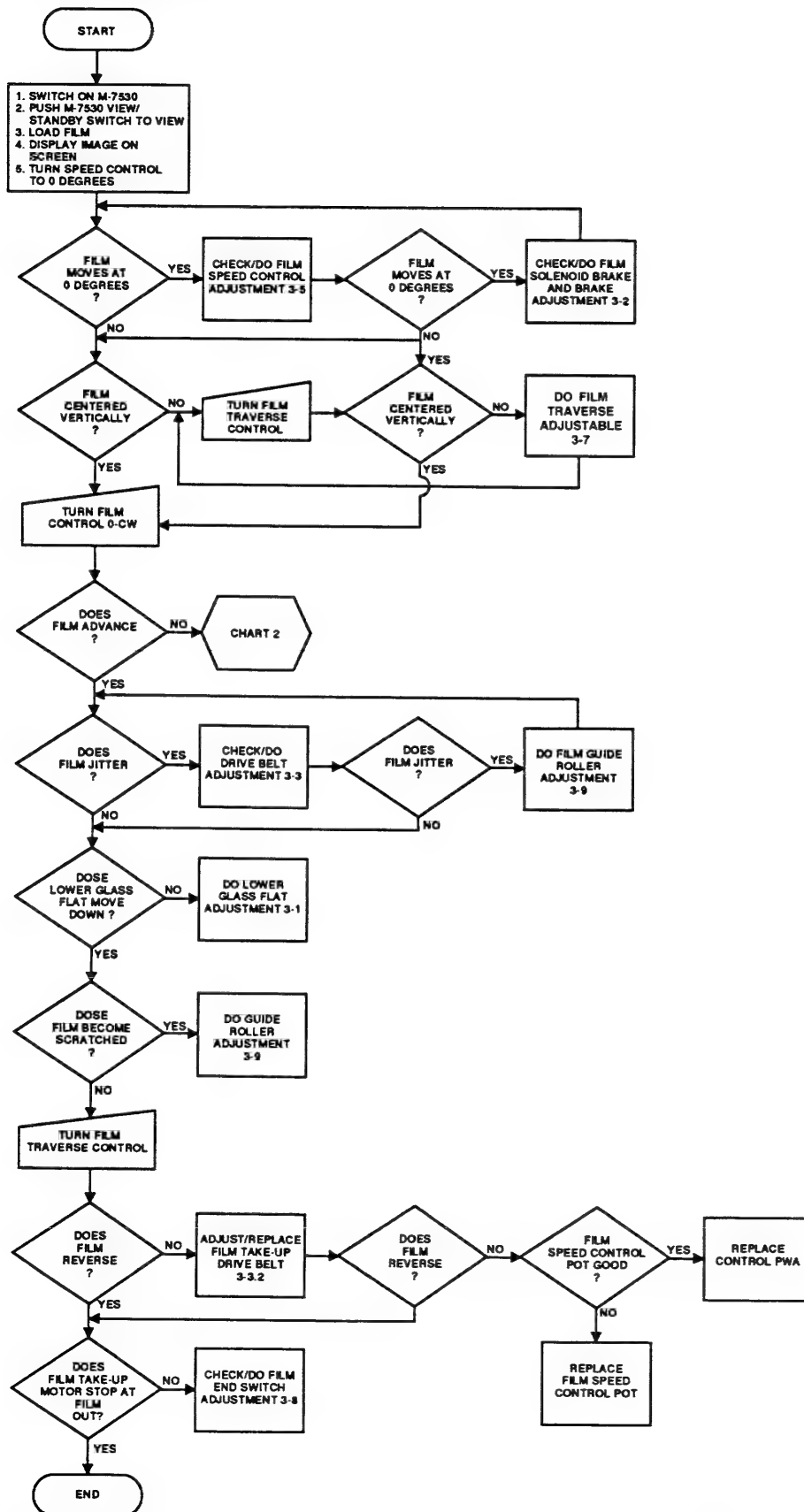
* 7-5. DC POWER DISTRIBUTION/SYSTEM

* Located in the binder pocket.

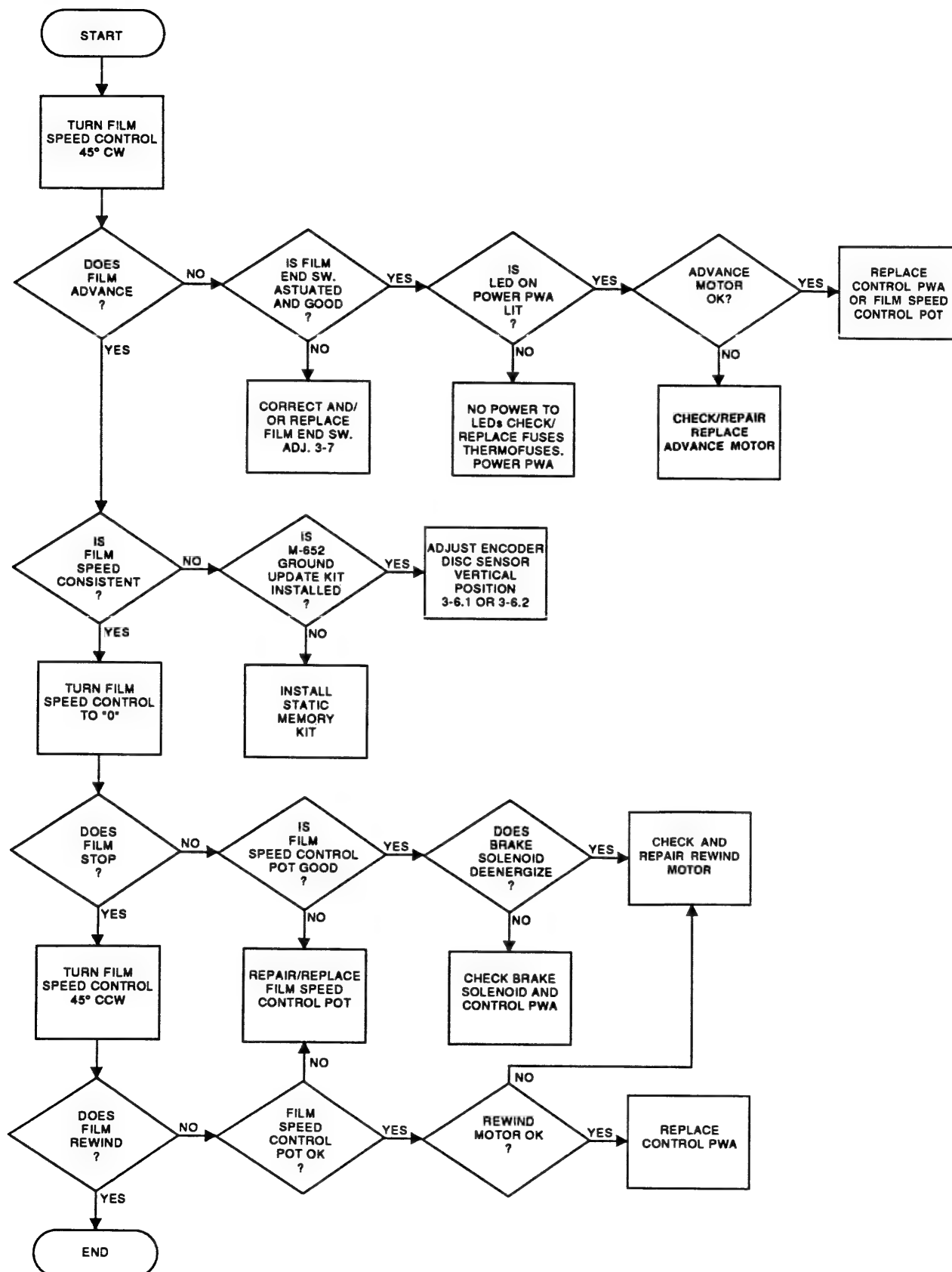
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8-1. OPERATIONAL SEQUENCE



8-2. FILM SCANNING



8-3. CHECKLIST

BRAKE DISC

- Problem:** Brake Disc gets dirty too soon.
- Correction:**
1. Clean Brake Disc per PEM Procedure.
 2. Do Adjustment 3-2. Brake Solenoid and Brake Disc, page 3-2.
- Problem:** Set Screw loosens.
- Cause:** No Loctite on threads.
- Correction:** Add Loctite to threads.
- Problem:** Takes too long to remove covers.
- Cause:** Many Screws.
- Correction:**
1. Use powered screwdriver.
 2. Cut Rear Cover in half.

ENCODER SENSOR

- Problem:** During automatic scanning, the motors run intermittently at full speed for no apparent reason.
- Cause:** Misadjusted Encoder Sensor. This sensor is factory adjusted but we have found that earlier machines lose their adjustment during shipment.
- Correction:** Do Adjustment 3-6.1 Encoder Disc Sensor Vertical Position (LED Method), page 3-8 or 3-6.2 Encoder Disc Sensor Vertical Position (Oscilloscope Method), page 3-9.

FILM SPEED

- Problem:** Casual operators using the M-652 in some libraries are not familiar enough with the system to use it correctly at its high film speed of ten feet per second. Many librarians have requested that the M-652 be modified to limit its maximum speed.
- Solution:** Increase the value of R77 on the Control PWA (Figure 1). The present value of 6.1 k-Ohms limits the film speed to approximately 10 feet per second. By increasing the resistance to 10.0 k-Ohms the film speed would be reduced to approximately 5 feet per second.

WARNING

NEVER DECREASE THE VALUE OF R77 ON THE CONTROL PWA TO A VALUE LOWER THAN 6.19 K-OHMS OR EXCESSIVELY HIGH FILM SPEED WILL RESULT.

Maximum Film Speed Limiter
 $6.19 K\Omega \approx 10 \text{ ft./sec.}$
 $10.00 K\Omega \approx 5 \text{ ft./sec.}$

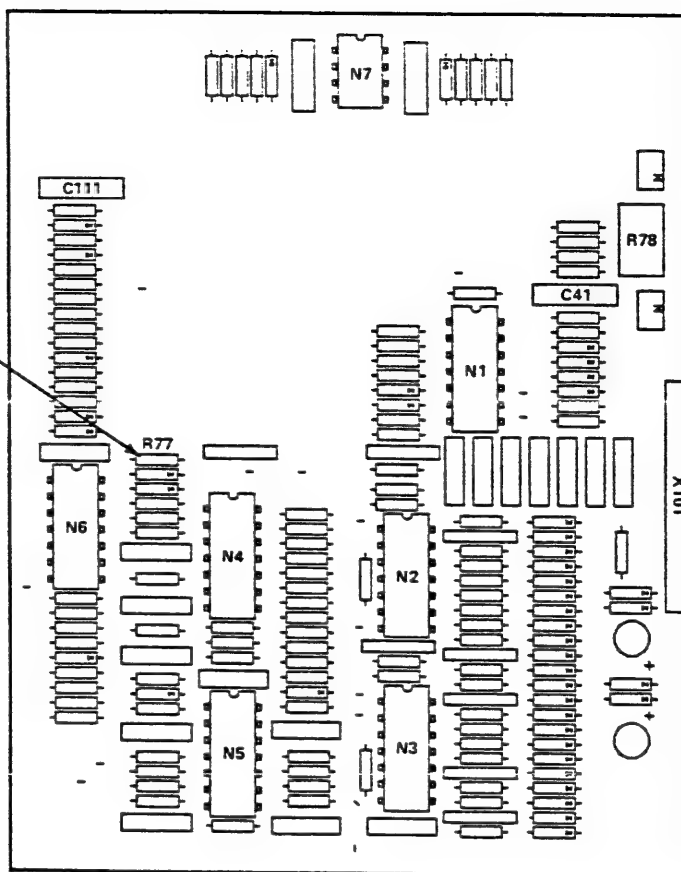


Figure 1

SPINDLE for 35 mm Reels

Problem: The existing Spindle (Section 2, Item 32A) does not securely hold 35 mm open core reels.

Cause: The existing Spindle was not designed for 35 mm open core reels.

Correction: Replace the existing Spindle with a new Special Spindle for 35 mm Reels (Section 2, Item 32B). The Part Number is 78-8051-9608-2.

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

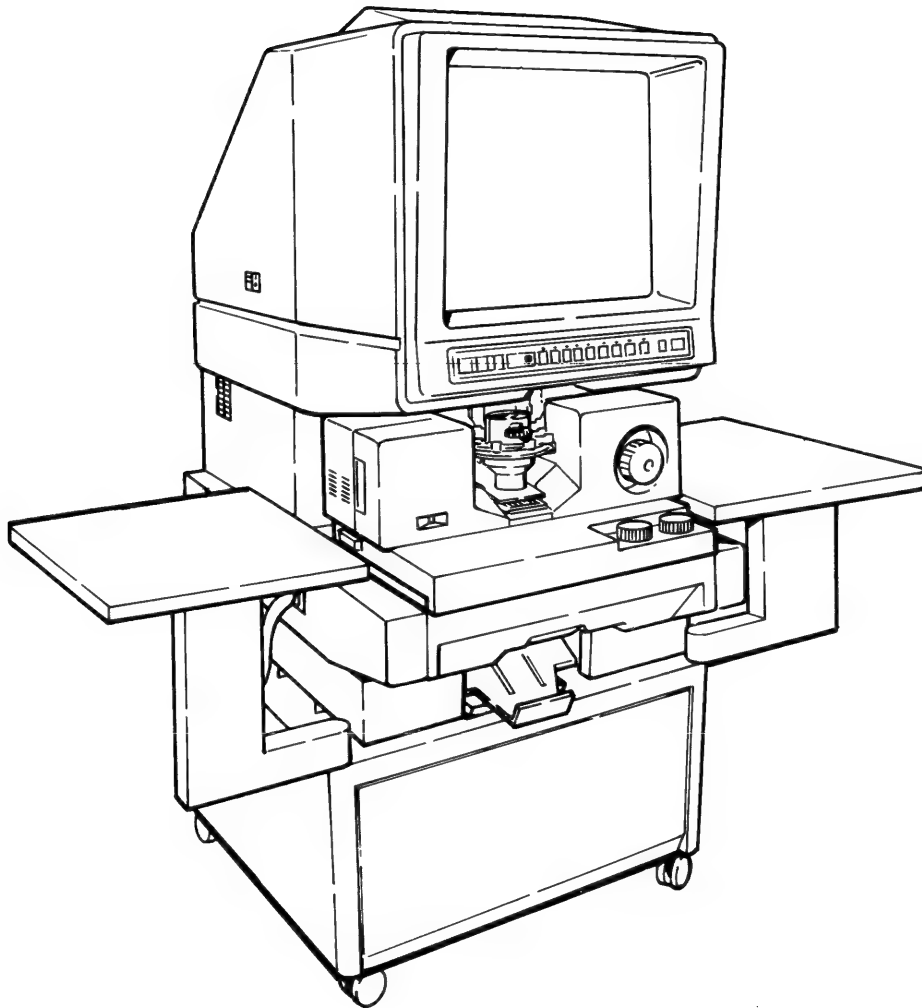
Problem: _____

Cause: _____

Correction: _____

Field Service Handbook

M654 210 Cartridge ANSI Transport



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1-1. DESCRIPTION

The 3M Model 654 "210 CAT" (Cartridge ANSI Transport) is a self-contained motorized 16 mm film cartridge transport used on the M-7530 MFB 1100 M-7540 MFB Reader-Printer. A 3M Model 656 "Page Search" can be added for electronic page search.

1-2. APPLICATION

The M-654 is typically installed on the M-7530 or M-7540 where 3M or Kodak Ektamate 16 mm film cartridges are used.

1-3. MACHINE SPECIFICATIONS**Shipping Dimensions:**

Height: 415 mm (16.3 in.)
Depth: 560 mm (22.0 in.)
Width: 650 mm (25.6 in.)

Shipping Weight:

11 kg (24 lb)

Machine Dimensions:

Height: 175 mm (6.9 in.)
Depth: 365 mm (14.4 in.)
Width: 500 mm (19.7 in.)

Machine Weight:

10 kg (22.0 lb)

Power Requirements:

Voltage: 27 VAC
Current: 3 A
Frequency: 50/60 Hz

Power Consumption:

64 watts average

Noise Level:

70 dbA maximum

Operating Environment:

10° C to 30° C (50° F to 86° F)
20% to 80% RH

1-4. SUPPLIES**16 mm Microfilm Cartridges:**

3M M-75
Kodak Ektamate
Kodak Ektamate A

Film Speed:

4.5 mm/sec (0.2 in/sec) minimum
3 m/sec (10 ft/sec) maximum

Film Width:

16 mm

Film Thickness:

2.5 mil to 5.7 mil

Film Type:

Diazo
Dry Diazo
Silver Halide
Vesicular

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2-1. GENERAL

Read the installation instructions completely before setting up the machine.

CAUTION

An M-7530 Interface Harness Update Kit (78-8051-9698-3) must be installed on M-7530AJ machines prior to S/N YF610882 and M-7530AB machines prior to S/N YF611082 before applying power.

2-2. UNPACKING

The M-654 is shipped assembled except for the Lower Glass Flat Assembly. Perform the following inspection upon receipt of the machine:

1. Inspect the Shipping Carton for damage that could indicate damage to the machine.

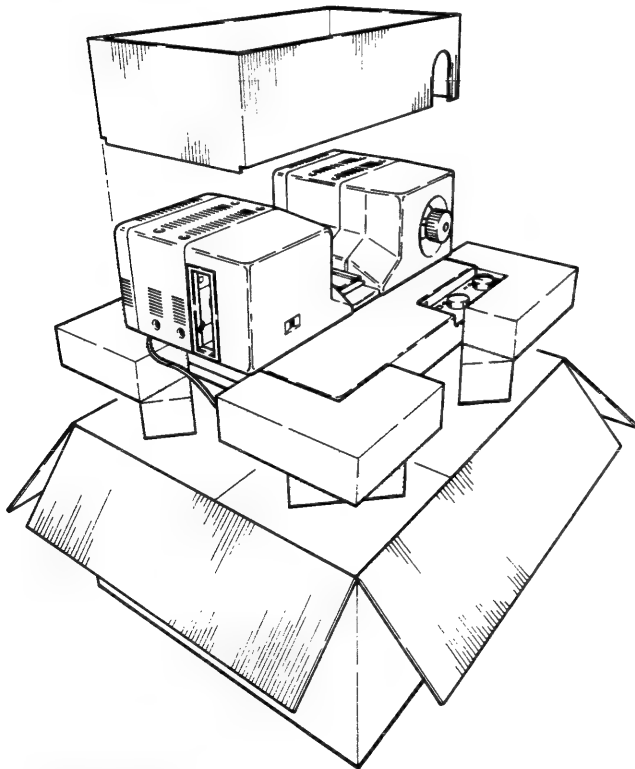


Figure 2-2A

2. Inspect the machine and uninstalled components (Figure 2-2A) for damage or missing parts.

3. Report any damage by completing the Product Registration Form and returning it to:

Quality Assurance
Office Systems Division/3M
235-2B-08, 3M Center
St. Paul, MN 55101-9924
Phone: (612) 733-4386

2-3. SET-UP

1. Remove both red Shipping Screws from the bottom of the machine (Figure 2-3A).

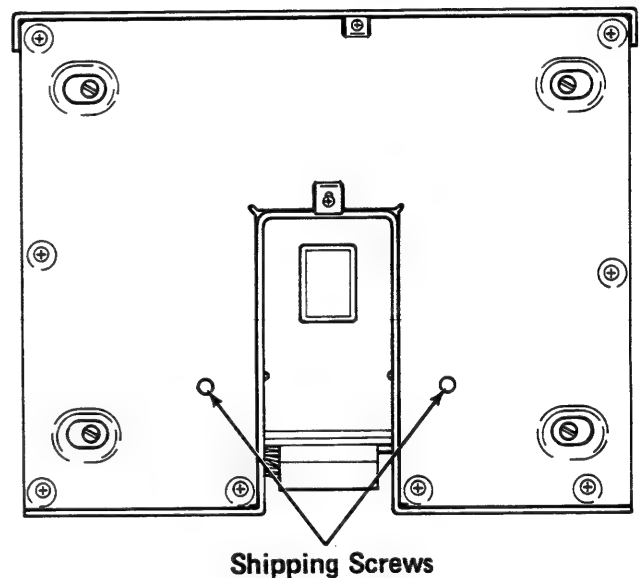


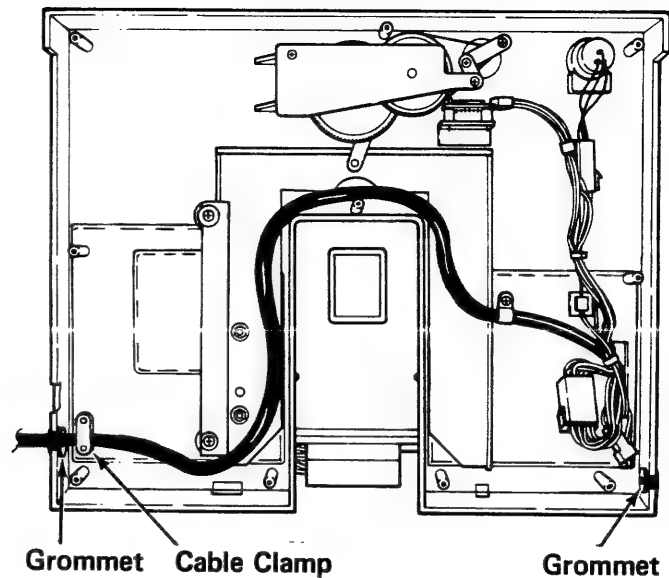
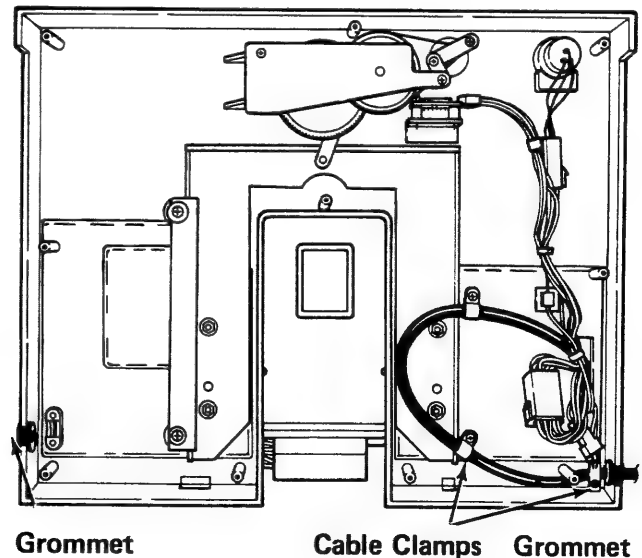
Figure 2-3A

Note

The M-654 is shipped with the Interface Harness exiting to the left (Figure 2-3B) to match connections on newer M-7530's and M7540's. Reroute the Interface Harness, if necessary, to the right (Figure 2-3C) for earlier M7530's.

- a. Remove the Bottom Cover (Disassembly 4-2.6).
- b. Disconnect one end of the Ground Strap.
- c. Remove both Cable Clamps (Figure 2-3B).

- d. Pull the Interface Harness out of the Base at the Grommet (Figure 2-3B).
 - e. Remove the open Grommet from the right side of the Base and reinstall it on the left side.
 - f. Reroute the Interface Harness to the right as shown in Figure 2-3C.
 - g. Reinstall the Cable Clamps (Figure 2-3C).
 - h. Reconnect the Ground Strap.
 - i. Reassemble the Bottom Cover.
2. Press the Power Switch of the Reader-Printer to "0" (OFF).
 3. Remove the Lens Assembly from the Reader-Printer (See MFB 1100 Operating Instructions).
 4. Remove the present Film Handler from the Reader-Printer (See MFB 1100 Operating Instructions).

**Figure 2-3B****Figure 2-3C**

5. Align the Cartridge ANSI Transport within the track of the Accessory Table of the Reader-Printer and push the Cartridge ANSI Transport in until the Latches engage (Figure 2-3D).
6. Plug the Wiring Harness from the M-654 into the M-7530 connector (Figure 2-3D).
7. Install the Lower Glass Flat Assembly (Figure 2-3E).
8. Reinstall the Lens Assembly (See MFB 1100 Operating Instructions).
9. Turn the M-654 Film Speed Control to "0" (Figure 2-3F).

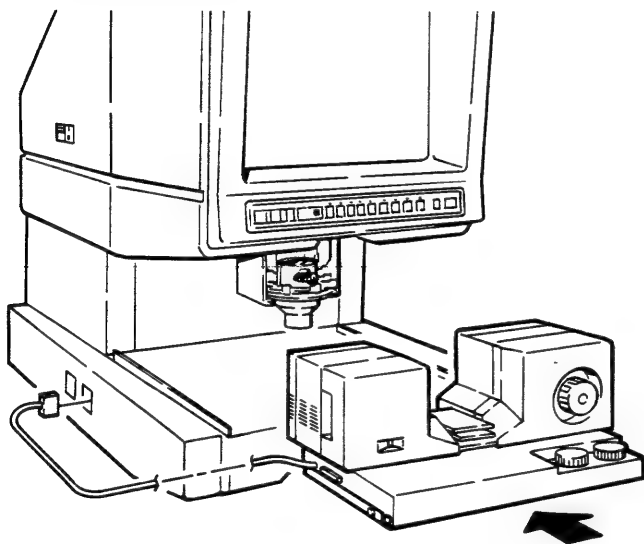


Figure 2-3D

10. Open the Right Side Door and replace the 5A, 250V Line Fuse to the film handler with a Slo-Blo Fuse having the same rating.

Note

For M-7530 machines only having J100 and J101 on the left side, the Line Fuse(s) are located within the lower left base. Remove the Lower Left Cover for access. For AL machines, replace the 5A, 250V Line Fuse with a Slo-Blo Fuse having the same rating. For AJ machines, replace the 2A, 250V Line Fuse and the 3A, 250V Line Fuse with Slo-Blo fuses having the same ratings.

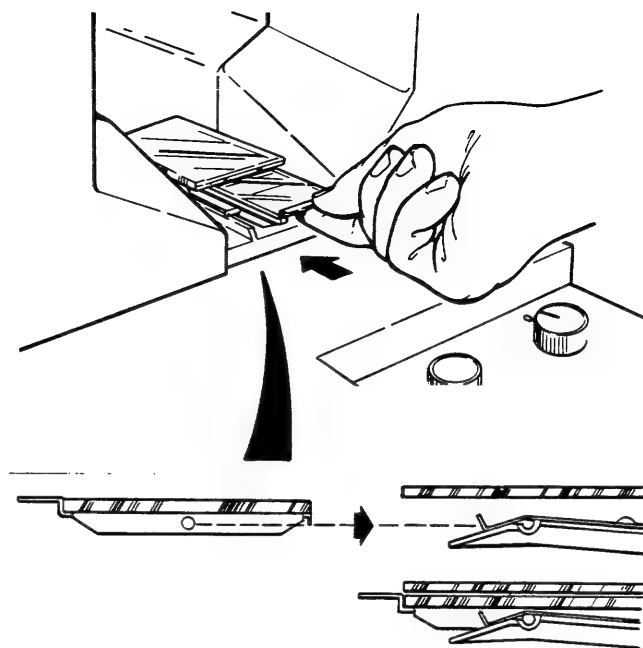


Figure 2-3E

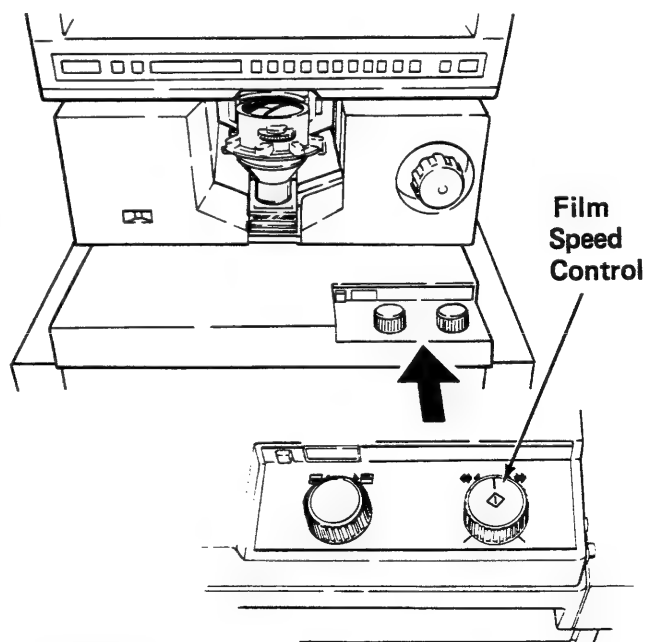


Figure 2-3F

2-4 ADJUSTMENTS

There are no initial adjustments to be made.

2-5 INITIAL CHECK

1. Press the M-7530 Power Switch to "1" (ON). The Blower Motor (M5) should operate, the Brake Disk Solenoid (Y7) should activate releasing the Brake Disk, the Film Advance Motor (M2) should run, and the Film Chute solenoid (Y6) will activate pulling the Film in. Then, the Film Chute Solenoid (Y6) should deactivate pushing the Film Chute out, and the Brake Disk Solenoid (47) should deactivate stopping the Film Take Up Shaft.
2. Load a Film Cartridge (210 CAT Operating Instruction). The M-654 should automatically thread the film leader onto the Film Take-Up Reel.
3. Turn the Film Speed Control (Figure 2-5A) fully clockwise. The film should move quickly to the right as the Odometer continually displays an increasing number. Near the end of the film, the film should slow down and stop, and the Lower Glass Flat should clamp.

Note

Film will not automatically slow down and stop near the end of the roll if the cartridge has a filler.

4. Turn the Film Speed Control fully counterclockwise. The Odometer should continually display a decreasing number. Before the film is pulled off the Take-Up Reel it should slow down. When the film is fully rewound the cartridge should eject.
5. Return the Film Speed Control to "0".

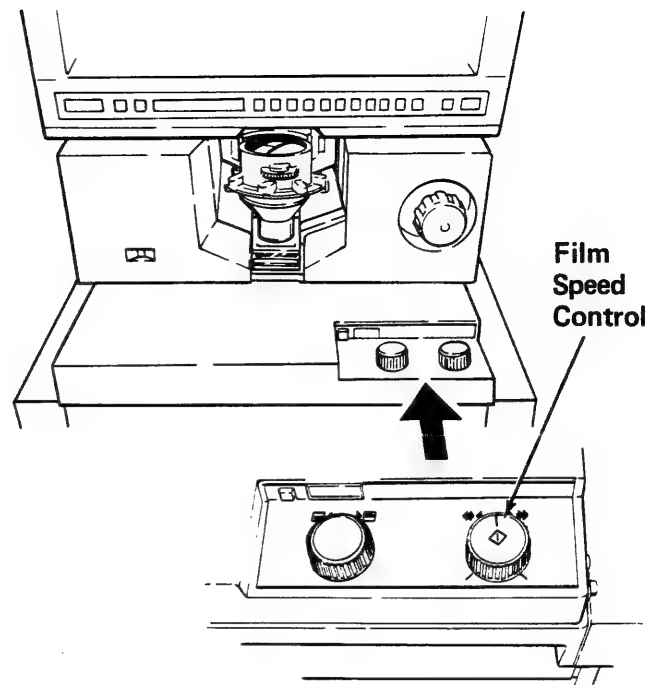


Figure 2-5A

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3-1. GENERAL

Review and understand each procedure before making any adjustments. The list of symptoms given should not be considered complete or in any order. All directions are referenced from the front of the M-654.

3-2. FILM GUIDE ROLLERS

Symptoms

Scratches on film
 Looping film
 Mistracking and wrong blip count
 Jerky film movement during slow speed

Specification

Film should move between the Upper and Lower Glass Flats without touching during fast or slow film scanning.

The Film Guide Rollers should be equally spaced from the Metal Plate.

The gap between stationary taut film and the Upper Glass Flat should be 0.0015 in. (0.04 mm).

Special Tools

Feeler Gauge
 Adjustment Tool 78-8012-6552-7

Measurement

1. Switch ON the Reader-Printer and load a Film Cartridge.
2. Remove the Front Left Cover (Disassembly 4-2.1, page 4-1).
3. Place the Film Guide Roller Adjustment Tool (78-8012-6552-7) against the 16mm flange of the Left Film Guide Roller (Figure 3-2A). The tool should touch the Metal Plate of the M-654.
4. Repeat Step 3 but for the Right Film Guide Roller.
5. Remove the Lower Glass Flat (210 CAT Operating Instruction).
6. Insert a 0.0015 in. (0.04 mm) Feeler Gauge between the Upper Glass Flat and

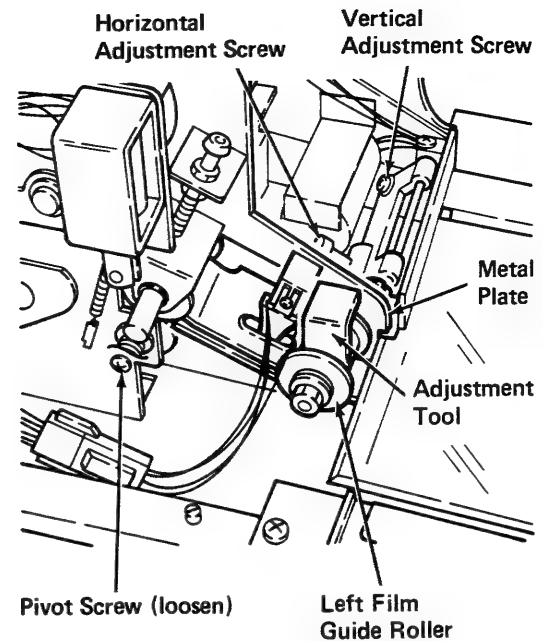


Figure 3-2A

top of the film. The Viewing Screen of the Reader-Printer should display the shadow of the Feeler Gauge adjacent to an image.

7. While pressing the film against the Feeler Gauge, focus an image.
8. Remove the Feeler Gauge. The image should remain in focus. You may need to pull the film taut by holding the Film Reel and turning the Manual Scan Control clockwise.

Note

With the Reader-Printer Exposure Lamp on, sight between the film and the Upper Glass Flat. There should be a gap.

Adjustment

1. Switch OFF the Reader-Printer.
2. Disconnect and remove the M-654 (210 CAT Operating Instructions).
3. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
4. Remove the Top Left Cover (Disassembly 4-2.4, page 4-2).
5. Remove the Top Right Cover (Disassembly 4-2.5, page 4-3).

6. Loosen the Adjustment Screw for the Left Film Guide Roller and with the Film Guide Roller Adjustment Tool (78-8012-6552-7) against the 16mm Flange, push the Left Film Guide Roller and tool against the Metal Plate and retighten the Adjustment Screw (Figure 3-2A).
7. Repeat Step 6 but for the Right Film Guide Roller (Figure 3-2B).
8. Loosen the Pivot Screw and turn the Adjustment Screw for the Left Film Guide Roller (Figure 3-2A) clockwise to lower the Left Film Guide Roller or counterclockwise to raise the Left Film Guide Roller.
9. Loosen the Adjustment Nut and turn the Adjustment Screw (Figure 3-2B) clockwise to lower the Right Film Guide Roller or counterclockwise to raise the Right Film Guide Roller.
10. Repeat Measurement Steps 3 through 8.
11. Put a dab of Loctite on the Adjustment Screws.
12. Tighten the Pivot Screw.

Note

Move the Return Spring of the Film Clamp Solenoid Y5 (Figure 3-2B) to a hole further to the right for greater return tension.

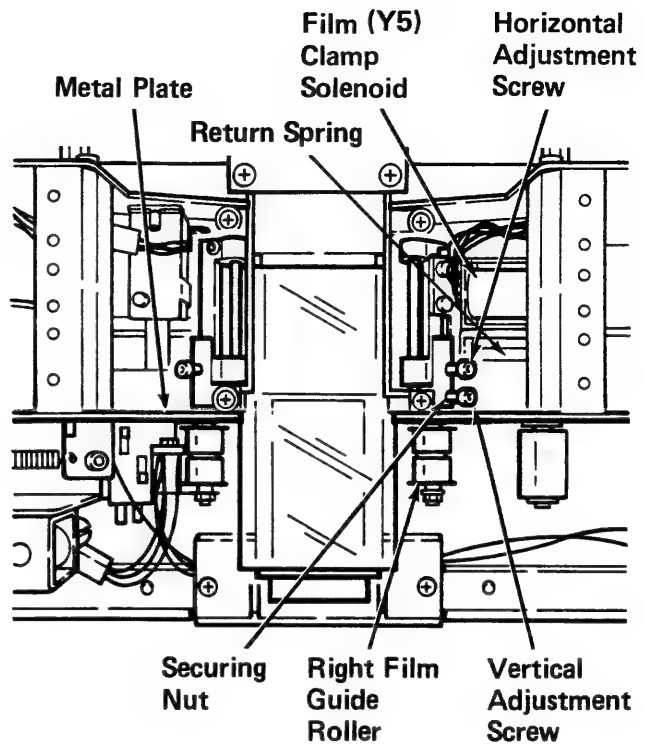


Figure 3-2B

3-3. BRAKE DISC

Symptoms

M654: Film creeps with Film Speed Control at "0".

M656: Inconsistent registration/error codes 400 to 599.

Specification

There should be no film movement when power is applied and the Film Speed Control is at "0".

When used with Page Search, the M-654 must automatically register the selected blip within ± 0.5 inch (± 12.7 mm) of the blip magnified at 47x on the screen.

Special Tools

Feeler Gauge

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Remove the Top Right Cover (Disassembly 4-2.5, page 4-3).
6. Switch the Service Switch OFF.
7. Reconnect the M-654 and switch ON the Reader-Printer.
8. Turn the Film Speed Control to Diagnostic Code 37.
9. Momentarily press the Reset Button and turn the Film Speed Control fully counterclockwise to a 00 Status Code.
10. Turn the Film Speed Control clockwise to Status Code 08.
11. Press and hold the Reset Button to actuate the Brake Solenoid (Y7).
12. Insert a 0.305 mm (0.012 in.) Feeler Gauge between the Metal Plate and the Brake Disc (Figure 3-3A). The gauge should be able to move with some resistance.

Adjustment

1. Loosen the Adjustment Screw for the Brake Disc (Figure 3-3A).
2. Pull the Brake Disc away from the Metal Plate by pulling the Plunger of the Brake Solenoid Y7 (Figure 3-3A) to the front and insert a 0.305 mm (0.012 in.) Feeler Gauge between the Metal Plate and Brake Disc.
3. Push the Brake Disc against the Feeler Gauge and tighten the Adjustment Screw.
4. Repeat Measurement Steps 11 and 12.
5. Switch ON the Service Switch to exit the Diagnostic Mode.

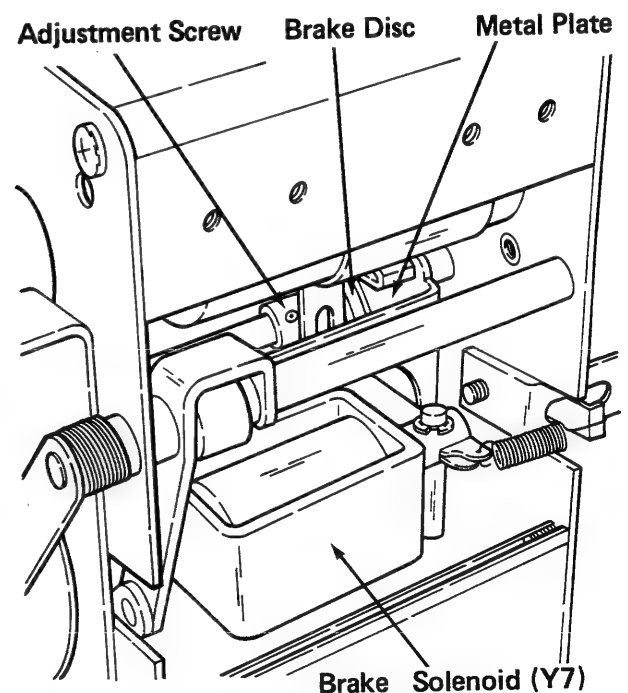


Figure 3-3A

3-4. CARTRIDGE DRIVE HUB

Symptoms

Film reel jams or welds to 3M cartridge case
Hub does not drive reel (Drive pins not engaged)

Cartridge does not eject (Hub partially engaged)

Specification

When the Cartridge Drive Hub is fully engaged with a black (G01) 3M Film Cartridge, the reel should not rub either wall of the cartridge when the Film Reverse Motor (M1) is turning.

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Insert a black (G01) 3M Film Cartridge.
3. Turn the Film Speed Control clockwise about 90° to advance film slowly.
4. Listen for a rubbing sound from the area of the Film Cartridge. There should be no rubbing sound.

Adjustment

1. Rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Remove the Front Left Cover (Disassembly 4-2.1, page 4-1).
6. Remove the leader from the film of a black (G01) 3M Film Cartridge.
7. Tape the film end to the body of the film inside the cartridge.
8. Switch OFF the Service Switch.

9. Reconnect the M-654 and Switch ON the Reader-Printer.
10. Insert the Test Film Cartridge.
11. Turn the Film Speed Control to Diagnostic Code 40.
12. Momentarily press the Reset Button and turn the Film Speed Control fully counterclockwise to a 00 Status Code.
13. Turn the Film Speed Control clockwise to a Status Code between 08 and 15.
14. While listening for noises indicating rubbing within the cartridge, press and hold the Reset Button to drive the Film Reverse Motor (M1). There should be no noises indicating rubbing of the reel on the cartridge walls.
15. Release the Reset Button and while pressing against the Drive Belt of the Film Reverse Motor (M1), turn the Hub Adjustment Nut clockwise to pull the Drive Hub in or counterclockwise to push the hub out (Figure 3-4A).
16. Repeat Steps 12 through 15 until the rubbing noise is eliminated or at least reduced to a minimum.
17. Switch ON the Service Switch to exit the Diagnostic Mode and remove the Test Cartridge.

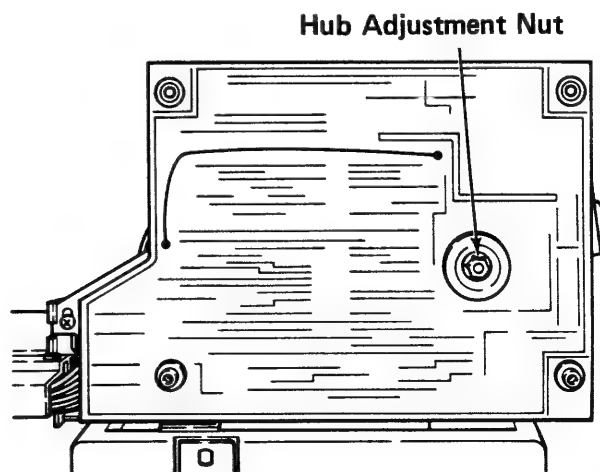


Figure 3-4A

3-5. ENCODER DISC ROLLER

Symptoms

Incomplete auto-thread
Film mistracking
Wrong Blip Count

Specification

The gap between the Encoder Disc Roller and Spring-Loaded Film Guide Roller should be 0.5 mm (0.020 in.) on each side and the surfaces of both rollers parallel.

Special Tools

Feeler Gauge

Measurement

1. Switch On the Reader-Printer, rewind Film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Front Left Cover (Disassembly 4-2.1, page 4-1).
5. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
6. Remove the Top Left Cover (Disassembly 4-2.4, page 4-2).
7. Remove the Film Guide.
8. Insert a 0.508 mm (0.020 in.) Feeler Gauge between the Encoder Disc and Spring-Loaded Film Guide Roller. The Feeler Gauge should be able to slip with some resistance.
9. Sight between the surfaces of the Encoder Disc Roller and Spring-Loaded Film Guide Roller and check that they are parallel.
10. Lift the Spring-Loaded Film Guide Roller and turn the Clutch Gear listening for abnormal noise and ensuring easy turning of the gears.

Adjustment

1. Remove the Peripheral PWA (Disassembly 4-3.2, page 4-4).
2. Remove the Processor PWA (Disassembly 4-3.3, page 4-5).
3. Remove the Retaining Ring and add or remove a Washer (IPB, Section 5, Item 21).
4. Loosen the Adjustment Screws securing the Bearing Shell (Figure 3-5A).
5. Move the Bearing Shell fully to the right (reference is front of M-654) then to the left approximately 2 mm (0.008 in.).
6. Holding the Bearing Shell in position, push the Clutch Gear to the front and release. The gear should freely move back.
7. Tighten the Adjustment Screws.
8. Repeat Measurement Steps 8 through 10.

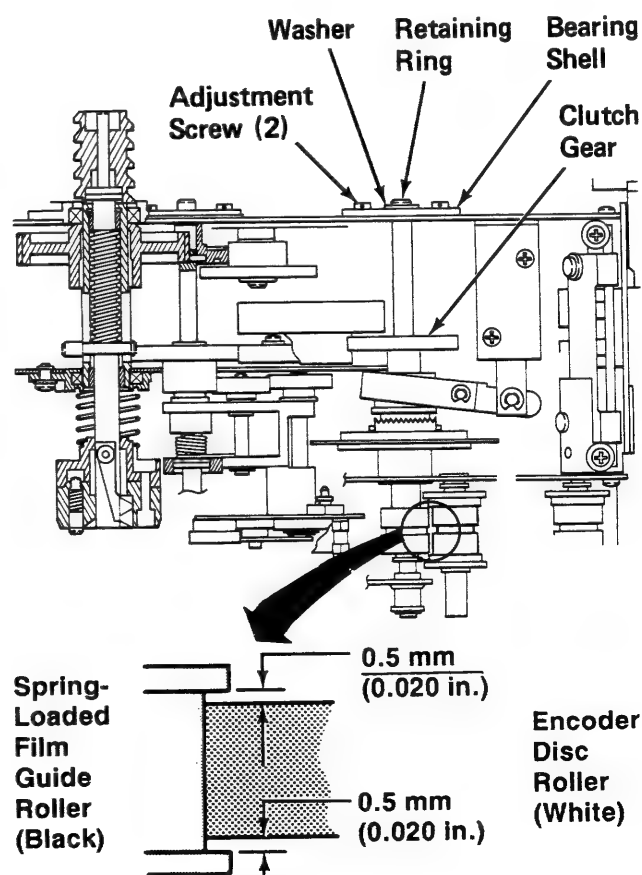


Figure 3-5A

3-6. FILM CHUTE PARALLELISM

Symptoms

Incomplete auto-thread
Error Code 1006 at power up

Specification

The Upper Right Pivot Arm and the Lower Right Pivot Arm must be parallel with each other within 0.13 mm (0.005 in.).

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Remove the Front Right Cover (Disassembly 4-2.2, page 4-1).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Remove the Top Right Cover (Disassembly 4-2.5, page 4-3).
6. Remove the Film Chute (Disassembly 4-9, page 4-13).
7. Gently push the Left Pivot Arm (Figure 3-6A) in toward the Take-Up Chute Cover until the Upper Right Pivot Arm touches the plastic Cover (Figure 3-6B).
8. Check the position of the Lower Right Pivot Arm. The arms are parallel if it is aligned with the Cover within 0.13 mm (0.005 in.). If it has gone under the Cover or has not yet reached the Cover, it is not aligned. See Figure 3-6A.

Note

The Lower Right Pivot Arm will normally not touch the Cover. The measurement can be "eyeballed" to see if the Lower Right Pivot Arm lines up with the Cover or a 0.13 mm (0.005 in.) Feeler Gauge should **not** be able to slip between the edge of the Lower Right Pivot Arm and the Cover when the Gauge is parallel with the surface of the Cover.

Adjustment

1. Using two pliers grasp the Plate near the top and bottom and gently twist the Plate as necessary so the Upper Right Pivot Arm and the Lower Right Pivot Arm are vertically parallel with each other within 0.13 mm (0.005 in.). See Figure 3-6B.
2. Repeat Measurement Steps 7 and 8.

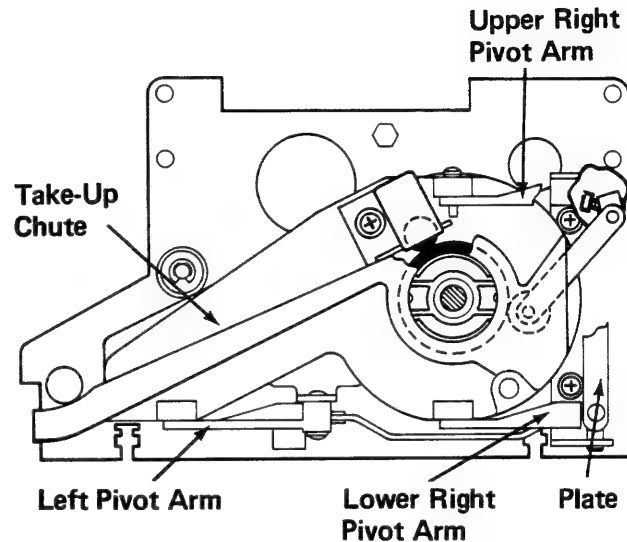


Figure 3-6A

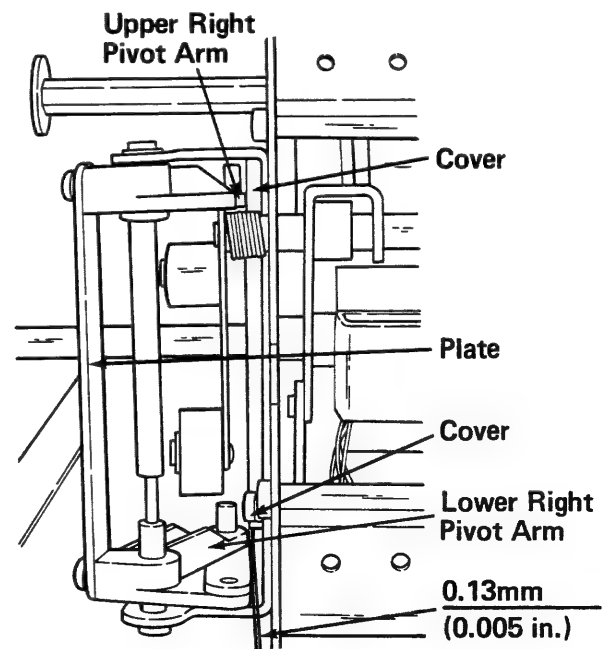


Figure 3-6B

3-7. FILM CHUTE OUT GAP

Symptoms

Misposition of splicing tab after loading
Error code 1006 at power up

Specification

The Film Chute must have a gap of 26.5 mm to 27.5 mm (1.04 in. to 1.08 in.) between the Metal Plate and the inside wall of the Film Chute when the Film Chute Solenoid (Y6) is de-energized.

Special Tools

Adjustment Tool

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Front Right Cover (Disassembly 4-2.2, page 4-1).
5. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
6. Remove the Top Right Cover (Disassembly 4-2.5, page 4-3).
7. Measure a 26.5 mm to 27.5 mm (1.04 in. to 1.08 in.) gap at point A (Figure 3-7A) between the Metal Plate and the inside wall of the Film Chute.

Adjustment

1. Loosen the Adjustment Screws for the Film Chute Out Switch (S10). See Figure 3-7B.
2. Loosen the Gap Adjustment Screw and move the Stopper for a gap of 26.5 mm to 27.5 mm (1.04 in. to 1.08 in.) at Point A between the Metal Plate and the inside wall of the Film Chute. See Figures 3-7A and 3-7B.
3. Tighten the Gap Adjustment Screw.

4. Repeat Measurement Step 7.
5. Do Film Chute Out Switch (S10) Adjustment 3-10.9, page 3-24.

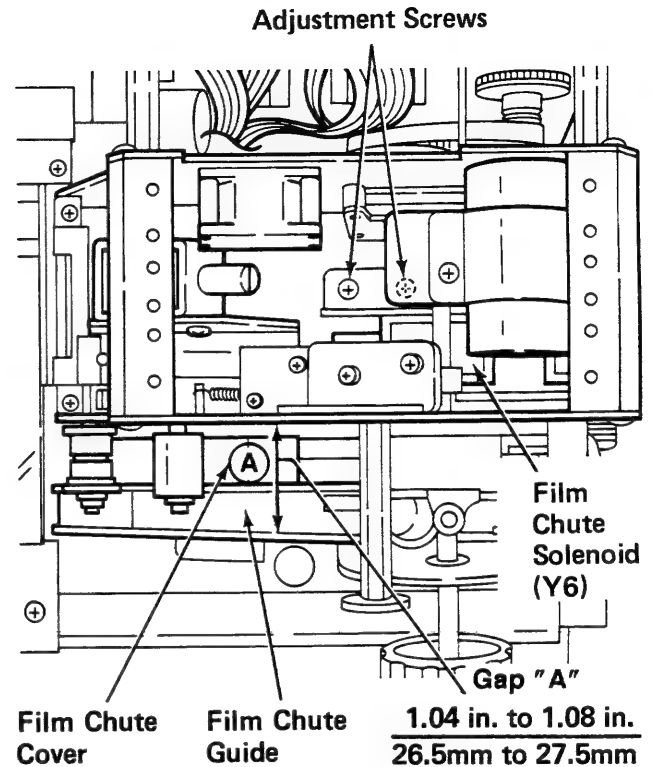


Figure 3-7A

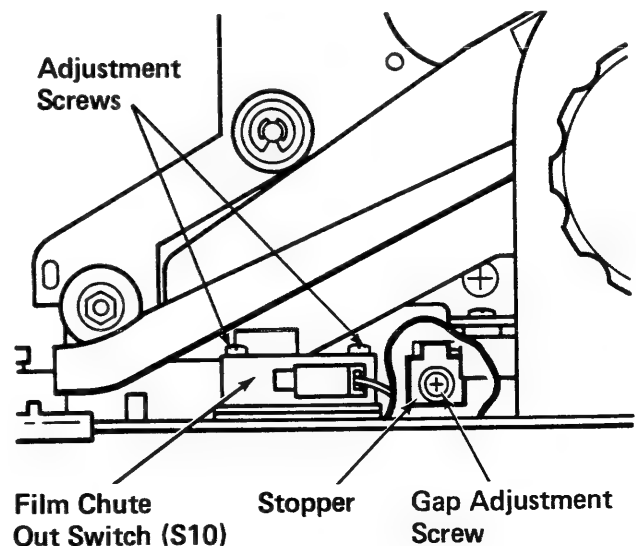


Figure 3-7B

3-8. FILM CHUTE IN GAP

Symptoms

Incomplete auto-thread
Error code 1006 at power up
Film Chute Solenoid (Y6) hums when energized

Specification

The Film Chute must have a gap of 8.0 mm (0.315 in.) between the metal plate and the inside wall of the Film Chute when the Film Chute Solenoid (Y6) is energized.

Special Tools

Adjustment Tool 78-8060-7363-7

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Front Right Cover (Disassembly 4-2.2, page 4-1).
5. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
6. Remove the Top Right Cover (Disassembly 4-2.5, page 4-3).
7. Switch the Service Switch OFF.
8. Reconnect the M-654 and switch ON the Reader-Printer.
9. Turn the Film Speed control to Diagnostic Code 36.
10. Turn the Film Speed Control fully counterclockwise to a 00 Status Code, then clockwise to 05.

CAUTION

Do not energize the Film Chute Solenoid (Y6) too long or the thermofuse will open.

11. Press the Reset Button to actuate the Film Chute Solenoid (Y6) and measure the

gap at points A and B (Figure 3-8A) using Dimension C, 8.0 mm (0.315 in.), of the Adjustment Tool. The gauge should be able to move with some resistance at both points.

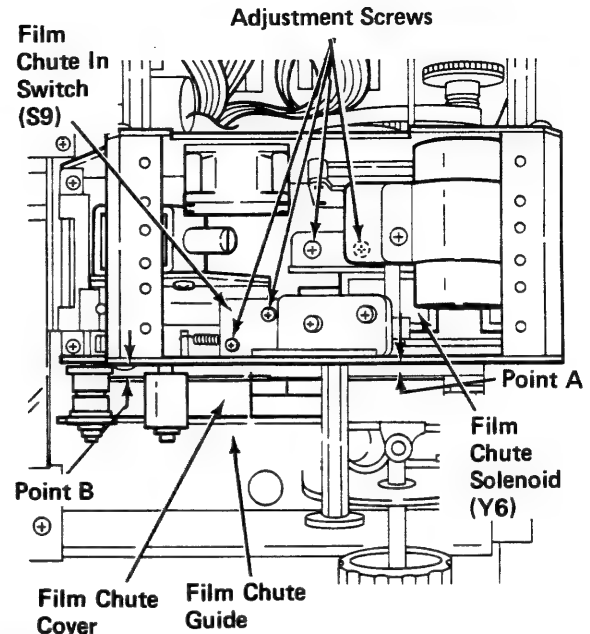


Figure 3-8A

Adjustment

1. Loosen the Adjustment Screws for the Film Chute In Switch (S9). See Figure 3-8A.
2. Loosen the Adjustment Screws for the Film Chute Solenoid (Y6). See Figure 3-8A.

CAUTION

Do not energize the Film Chute Solenoid (Y6) too long or the thermofuse will open.

3. Press the Reset Button and position the Film Chute Solenoid (Y6) for a gap of 8.0 mm (0.315 in.) at Point A using Dimension C of the Adjustment Tool. The gauge should be able to slip with some resistance.
4. Tighten the Adjustment Screws for the Film Chute Solenoid (Y6).
5. Loosen the Parallelism Adjustment Screw (Figure 3-8B).

CAUTION

Do not energize the Film Chute Solenoid (Y6) too long or the thermofuse will open.

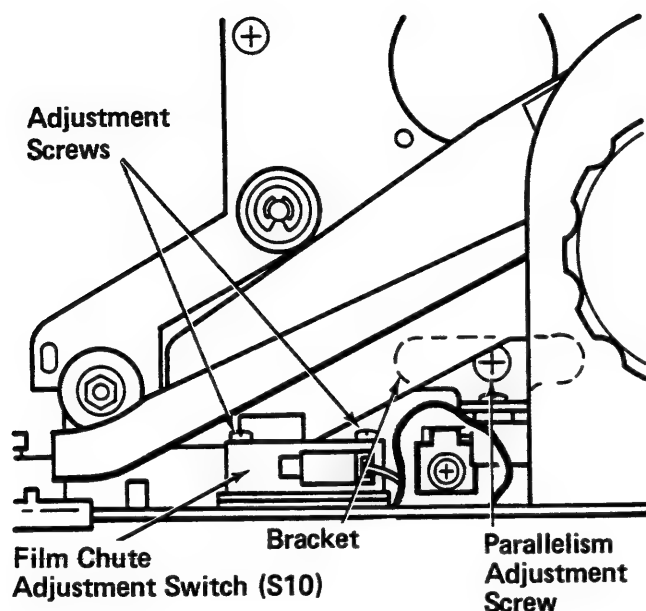
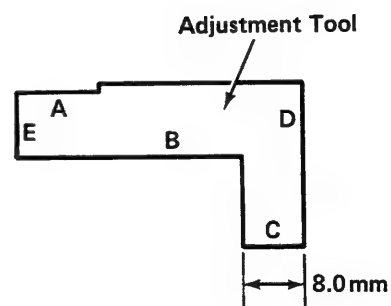


Figure 3-8B

6. Press the Reset Button and move the Bracket (Figure 3-8B) to the right to increase the gap at Point B (Figure 3-8A) or left to decrease the gap. Using Dimension C, 8.0 mm (0.315 in.), of the Adjustment Tool, the gauge should be able to slip with some resistance.
7. Tighten the Parallelism Adjustment Screw.
8. Repeat Measurement Step 11.
9. Switch ON the Service Switch to exit the Diagnostic Mode.
10. Do Film Chute In Switch (S9) Adjustment 3-10.8, page 3-23.



3-9. DRIVE BELTS

Symptoms

Jitter during slow film scan
Intermittent or no spindle drive
Belt breaks or strips teeth
Film Reverse Motor (M1) binds
Noisy operation

3-9.1. Film Reverse Motor (M1) Drive Belt

Specification

The Film Reverse Motor should start when the applied voltage is between 10% and 15%.

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Switch OFF the Service Switch.
6. Reconnect the M-654 and switch ON the Reader-Printer.
7. Turn the Film Speed Control to Diagnostic Code 40.
8. Press the Reset Button.
9. Turn the Film Speed Control counter-clockwise to a 00 Status Code.
10. While pressing the Reset Button, slowly turn the Film Speed Control clockwise. The Film Reverse Motor should have started between 10% and 15% of the applied voltage.

Adjustment

1. Remove the Peripheral PWA (Disassembly 4-3.2, page 4-4)
2. Remove the Processor PWA (Disassembly 4-3.3, page 4-5).

Note

Protect the printed wiring assemblies from shorting.

3. Reconnect the Peripheral PWA with the Processor PWA.
4. Reconnect the Processor PWA.
5. Remove the Encoder Disc for the Film Reverse Motor (Disassembly 4-3.4, page 4-5).
6. Loosen the Pivot Screw and Adjustment Screws securing the Film Reverse Motor (Figure 3-9.1A).
7. Decrease belt tension if the Film Reverse Motor started at a voltage higher than 15%.
8. Increase belt tension if the Film Reverse Motor started at a voltage lower than 10%.
9. Tighten the Adjustment Screws and Pivot Screw.
10. Repeat measurement steps 7-10.
11. Switch ON the Service Switch to exit the Diagnostic Mode.

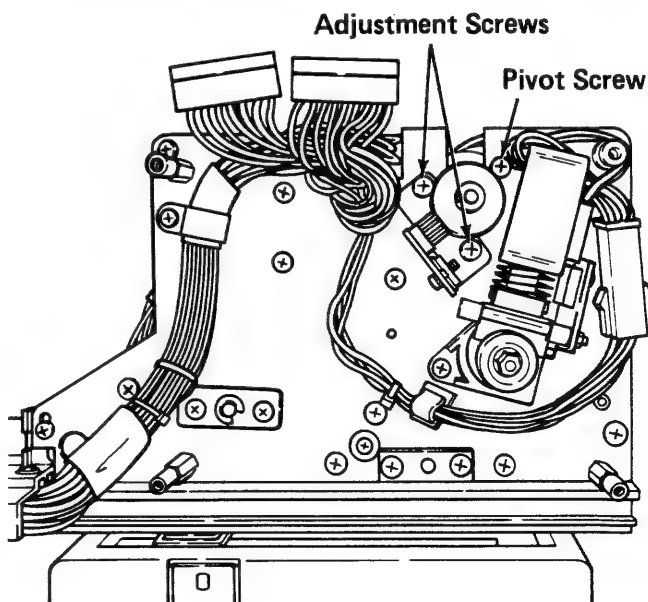


Figure 3-9.1A

3-9.2. Film Advance Motor (M2) Drive Belt**Symptoms**

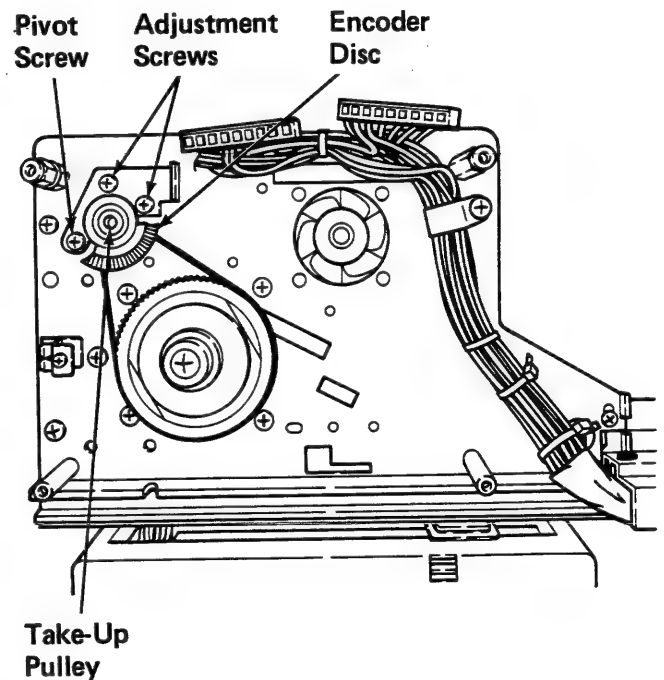
Jitter during slow film scan
Belt breaks or strips teeth
Take-up reel drive intermittent or gone
Film Advance Motor (M2) binds
Noisy operation

Specification

The Film Advance Motor should start when the applied voltage is between 10% and 15%.

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
 2. Switch OFF the Reader-Printer.
 3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
 4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
 5. Switch OFF the Service Switch.
 6. Reconnect the M-654 and switch ON the Reader-Printer.
 7. Turn the Film Speed Control to Diagnostic Code 42.
 8. Press the Reset Button.
 9. Turn the Film Speed Control counter-clockwise to a 00 Status Code.
 10. While pressing the Reset Button, slowly turn the Film Speed Control clockwise. The Film Advance Motor should have started between 10% and 15% of the applied voltage.
3. Loosen the Pivot Screw and Adjustment Screws (Figure 3-9.2A) securing the Film Advance Motor.
 4. Decrease belt tension if the Film Advance Motor started at a voltage higher than 15%.
 5. Increase Belt tension if the Film Advance Motor started at a voltage lower than 10%.
 6. Tighten the Adjustment Screws and Pivot Screw.
 7. Repeat measurement steps 7 thru 10.
 8. Switch ON the Service Switch to exit the Diagnostic Mode.

**Figure 3-9.2A****Adjustment**

1. Remove the Power PWA (Disassembly 4-3.1, Page 4-4).
2. Remove the Encoder Disc for the Film Advance Motor (Disassembly 4-3.4, page 4-5).

3-9.3. Film Thread Motor (M3) Drive Belt

Symptoms

Film Thread-up Motor (M3) binds
Belt breaks or strips teeth
Noisy operation

Specification

The Film Thread Motor should start when the applied voltage is between 10% and 15%.

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Switch OFF the Service Switch.
6. Reconnect the M-654 and switch ON the Reader-Printer.
7. Turn the Film Speed Control to Diagnostic Code 43.
8. Press the Reset Button.
9. Turn the Film Speed Control counter-clockwise to a 00 Status Code.
10. While pressing the Reset Button, slowly turn the Film Speed Control clockwise. The Film Thread Motor should have started between 10% and 15% of the applied voltage.
3. Loosen the Adjustment Screws (Figure 3-9.3A) securing the Film Thread Motor.
4. Decrease belt tension if the Film Thread Motor started at a voltage higher than 15%.
5. Increase belt tension if the Film Thread Motor started at a voltage lower than 10%.
6. Tighten the Adjustment Screws.
7. Repeat Measurement Steps 7 through 10.
8. Switch ON the Service Switch to exit the Diagnostic Mode.

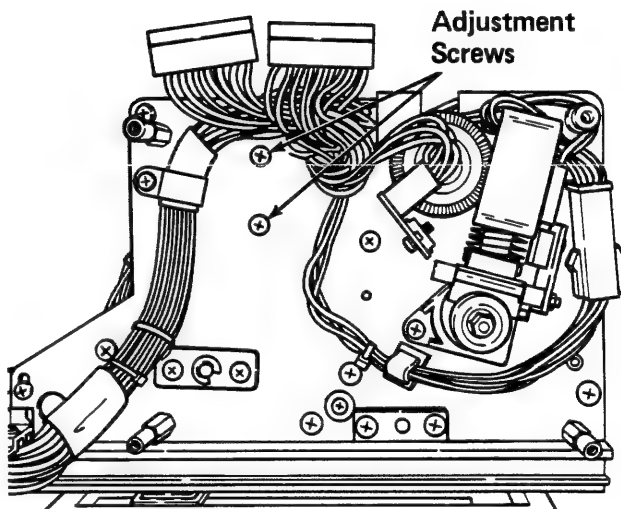


Figure 3-9.3A

Adjustment

1. Remove the Peripheral PWA (Disassembly 4-3.2, page 4-4).
2. Remove the Processor PWA (Disassembly 4-3.3, page 4-5).

3-10. SWITCHES

3-10.1. Spindle Position Switch (S2)

Symptoms

Error Code X720, X002, X575
Spindle does not retract

Specification

The Spindle Position Switch should switch ON when the Slide Gear is raised a minimum of 1.0 mm (0.039 in.) above the Worm Gear.

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Remove the Top Left Cover (Disassembly 4-2.4, page 4-2).
6. Remove the Peripheral PWA (Disassembly 4-3.2, page 4-4).
7. Switch the Service Switch OFF.
8. Reconnect the M-654 and switch ON the Reader-Printer.
9. Lift the Slide Gear (Figure 3-10.1A). The Hub should move to the front.
10. Turn the Speed Control to a Service Diagnostic Code of 02.
11. Manually lift the Slide Gear and insert a 1.0 mm (0.039 in.) Feeler Gauge between the Worm Gear and Slide Gear. The Status Code should be 1.
12. Continue to lift the Slide Gear to its limit. The switch should actuate at some distance before 0.20 mm (0.008 in.) travel of the switch remains. The Status Code should change to 0.

Adjustment

1. Loosen both Adjustment Screws securing the Spindle Position Switch (S2). See Figure 3-10.1A.

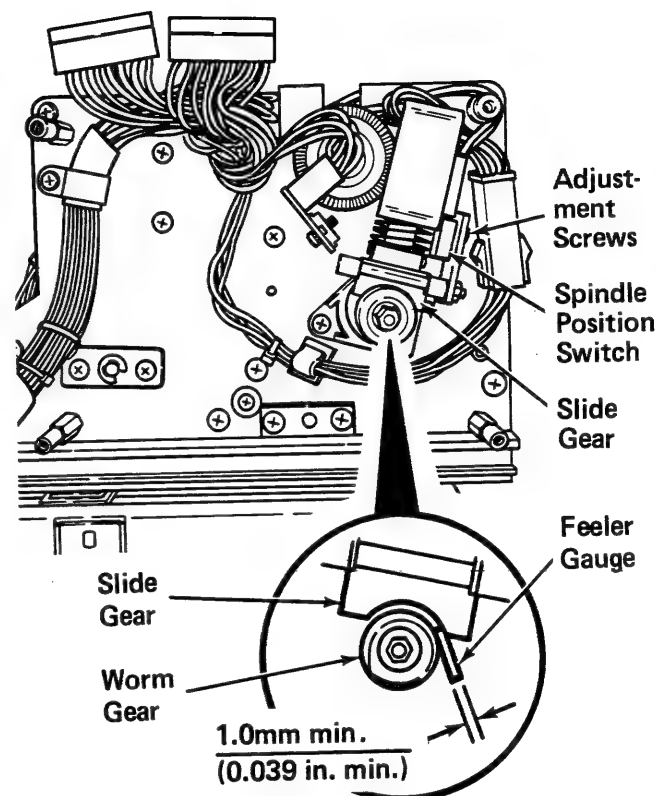


Figure 3-10.1A

2. Manually lift the Slide Gear and insert a 1.0 mm (0.039 in.) Feeler Gauge between the Worm Gear and Slide Gear.
3. Adjust the Spindle Position Switch (S2) for a 0 Status Code and tighten the Adjustment Screws.
4. Remove the Feeler Gauge and lower the Slide Gear. The Status Code should read 1.
5. Repeat Measurement Steps 10 and 11.
6. Switch ON the Service Switch to exit the Diagnostic Mode.

3-10.2 Reverse Motor Speed Sensor (S3)

Symptoms

Film pulls out of cartridge end

Specification

The Reverse Motor Speed Sensor (S3) should switch on and off when the Hub Shaft is turned and not always stop on the same status number.

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Remove the Top Left Cover (Disassembly 4-2.4, page 4-2).
6. Switch OFF the Service Switch.
7. Reconnect the M-654 and switch ON the Reader-Printer.
8. Manually lift the Slide Gear (Figure 3-10.2A). The Hub should move to the front.
9. Turn the Speed Control clockwise to a Diagnostic Code of 03. The Status Code should display a 0 or 1.
10. Manually turn the Hub very slowly. The Status Code should alternate 0 and 1.
11. Ensure the Reverse Motor Speed Encoder Disc does not touch the Reverse Motor Speed Sensor (S3) and that the Status Code does not always stop on the same number.

Adjustment

1. Remove the Peripheral PWA (Disassembly 4-3.2, page 4-4).
2. Remove the Processor PWA (Disassembly 4-3.3, page 4-5).

3. Loosen the Adjustment Screws for the Reverse Motor Speed Sensor (Figure 3-10.2A).
4. Position the Reverse Motor Speed Sensor so that the Encoder Disc is about 0.5 mm (0.020 in.) from the "S" side of the sensor and about halfway from the bottom of the U-Slot. See Figure 3-10.2B.
5. Tighten the Adjustment Screws.
6. Repeat Measurement Steps 10 and 11.
7. Switch ON the Service Switch to exit the Diagnostic Mode.

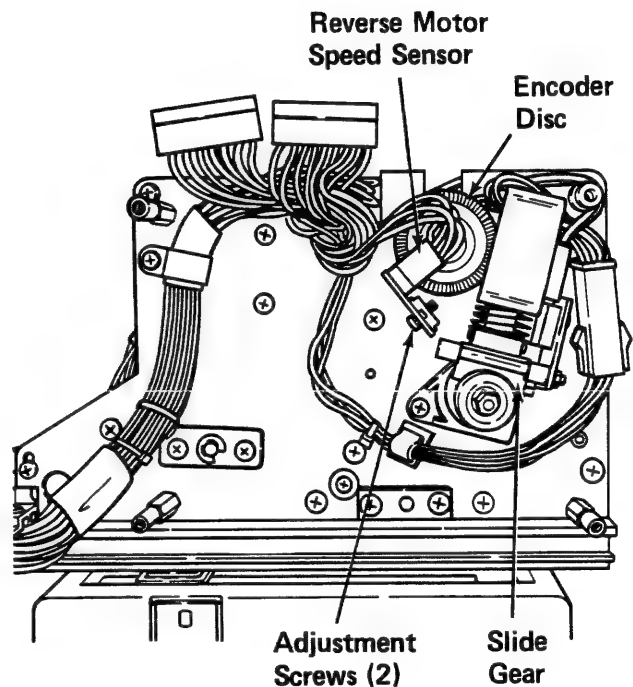


Figure 3-10.2A

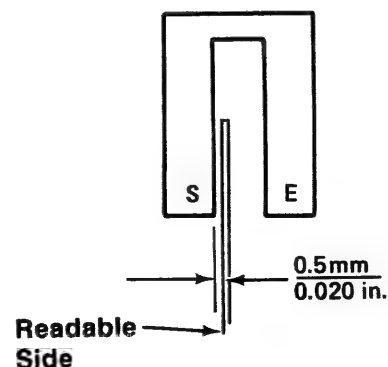


Figure 3-10.2B

3-10.3. Film Start Switch (S4)

Symptoms

Auto-thread does not start
Error Code X006, X310, X330, X080, X411,
X335, X410

Specification

The Film Start Switch (S4) should actuate when a Cartridge is fully inserted.

Special Tools

Feeler Gauge

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Remove the Front Left Cover (Disassembly 4-2.1, page 4-1).
6. Switch the Service Switch OFF.
7. Reconnect the M-654 and switch ON the Reader-Printer.
8. Turn the Film Speed Control to Diagnostic Code 04. The Status Code should read 0.
9. While holding a 0.20 mm (0.008 in.) Feeler Gauge between the actuator arm and body of the Film Start Switch (S4), slowly push the Plate to the right until the status code changes to read 1.
10. While holding a 0.20 mm (0.008 in.) Feeler Gauge between the actuator arm and body of the Film Start Switch (S4), continue to push the Plate to the right against the Feeler Gauge. The Plate should latch.

Adjustment

1. Loosen the Adjustment Screws (Figure 3-10.3A) and reposition the Film Start Switch (S4) as required.
2. Repeat Measurement Steps 9 and 10.
3. Switch ON the Service Switch to exit the Diagnostic Mode.

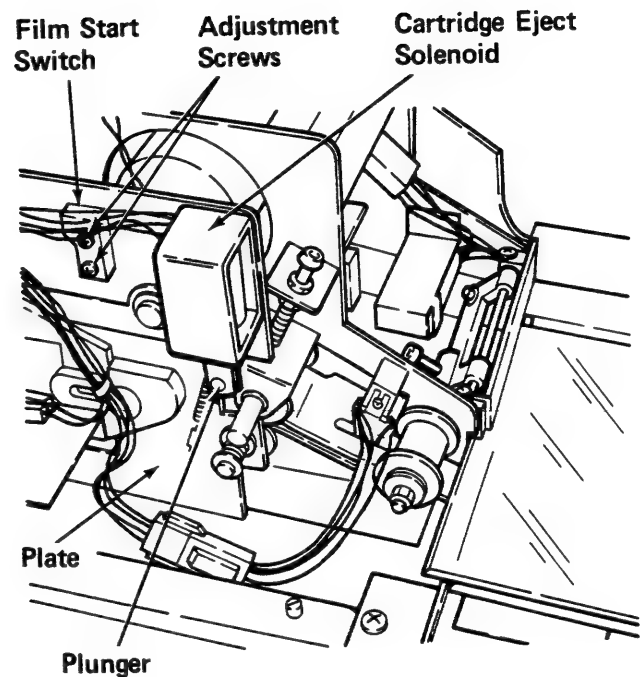


Figure 3-10.3A

3-10.4. 3M Cartridge Switch (S5)**Symptoms**

End of film is not sensed with 3M Cartridge
3M leader wedges in reel during rewind/eject
cycle

3M leader does not place splicing tab
properly after loading

Specification

The 3M Cartridge Switch (S5) should actuate with a Spool Shaft movement of 2.0 mm (0.079 in.). If misadjusted the Leader Sense Switch (S8) will not function.

Special Tools

Ruler

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Remove the Front Left Cover (Disassembly 4-2.1, page 4-1).
6. Switch the Service Switch OFF.
7. Reconnect the M-654 and switch ON the Reader-Printer.
8. Turn the Film Speed Control to Diagnostic Code 05. The Status Code should read 0.
9. Lay a 2.0 mm Ruler on the end of the Spool Shaft next to the Retaining Ring (Figure 3-10.4A).
10. Using the the inside edge of the Retaining Ring for reference, push the Spool Shaft to the front 2.0 mm (0.079 in.). An audible "click" should be heard and the Status Code should read 1.

Adjustment

1. Loosen the Adjustment Screws (Figure 3-10.4A) and reposition the Cartridge Switch (S5) as required.
2. Repeat Measurement Step 9 and 10.
3. Switch ON the Service Switch to exit the Diagnostic Mode.

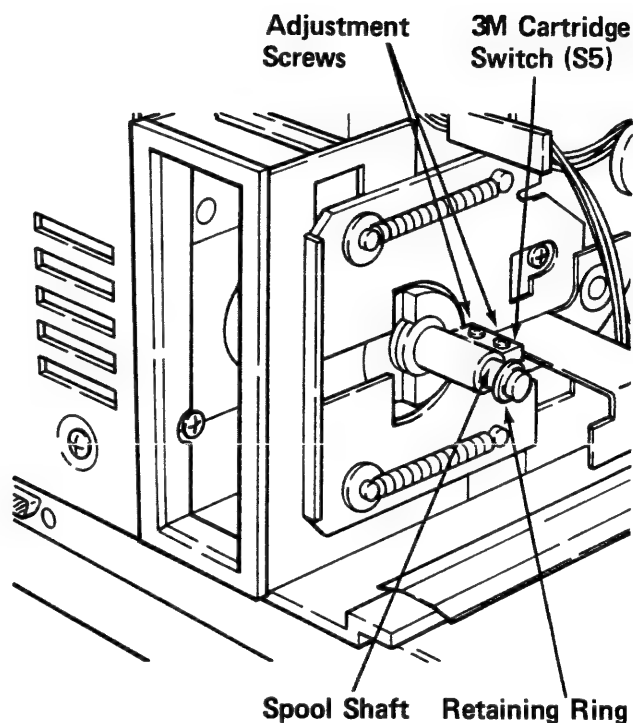


Figure 3-10.4A

3-10.5. Film Sensor (S6)

Symptoms

Error Code X310, X006, X706, X084, X550
Incomplete auto-thread

Specification

The Film Sensor (S6) should detect the presence of film when the sensor is approximately 0.030 in. (0.762 mm) from the top of the port of the Film Guide.

Special Tools

Feeler Gauge

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Front Left Cover (Disassembly 4-2.1, page 4-1).
5. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
6. Switch OFF the Service Switch.
7. Measure the gap between the Film Sensor (S6) and the top of the port of the Film Guide. The Gap should measure approximately 0.030 in. (0.762 mm).
8. Reconnect the M-654 and switch ON the Reader-Printer.
9. Turn the Film Speed Control to Diagnostic Code 06. The Status Code should read 0.
10. Slip a piece of film into the Film Guide from the front against the top of the film track past the Film Sensor (S6). The Status Code should read 1.
11. Remove the film. The Status Code should read 0.

12. Slip a piece of film into the Film Guide from the front against the bottom of the film track past the Film Sensor (S6). The Status Code should read 1.

Adjustment

1. Loosen the Adjustment Screw and reposition the Film Sensor (S6) as required (Figure 3-10.5A).

Note

The Film Sensor must be perpendicular to the film plane for accurate sensing.

2. Repeat Measurement Steps 7 and 10 through 12.
3. Switch ON the Service Switch to exit the Diagnostic Mode.

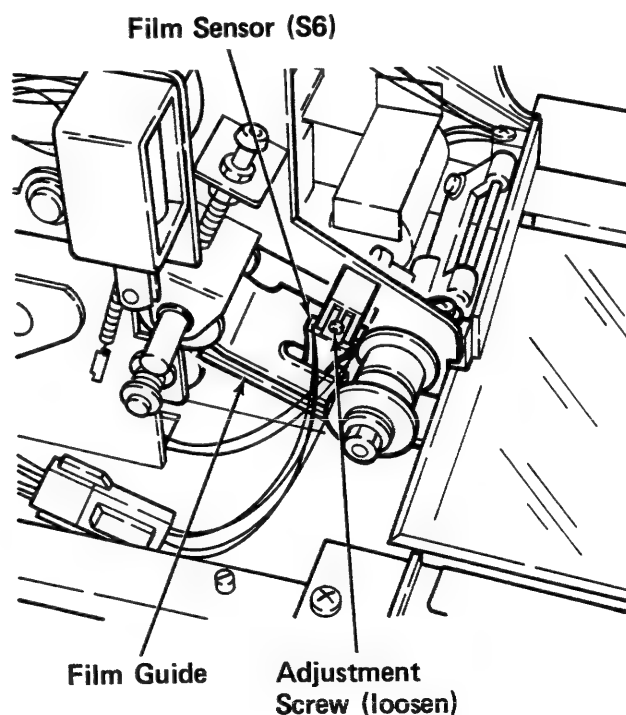


Figure 3-10.5A

3-10.6. Odometer Sensor (S7)

Symptoms

Film loops during loading
 Incomplete auto-thread
 Film Thread-Up Motor (M3) runs constantly at high speed
 Film wraps around odometer roller
 Film pulls out of end of cartridge
 Film does not slow down at end of roll
 Page search does not count
 Wrong Blip Count
 Lever or Film Reverse Motor (M1) belt breaks
 Motor(s) stop during film scan
 Error Code X712

Specification

The Encoder Disc must be parallel with the Odometer Sensor Slot. The measured voltage between TP201 and TP220, should be greater than 3 Vpp without the Disc rubbing the sensor. The Phase Shift between TP203 and TP222 should be 90°.

Special Tools

Inspection Mirror
 Oscilloscope

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Remove the Front Left Cover (Disassembly 4-2.1, page 4-1).
6. Switch the Service Switch OFF.
7. Reconnect the M-654 and switch ON the Reader-Printer.
8. Push the Plunger of the Odometer Clutch Solenoid (Y4) to the rear and while turning the Traverse Pulley of the Film Thread Motor (M3), check that the gears mesh smoothly and that the Encoder Disc

does not wobble (Figure 3-10.6A). The Encoder Disk should not touch the odometer sensor.

9. Turn the Speed Control to Diagnostic Code 17.

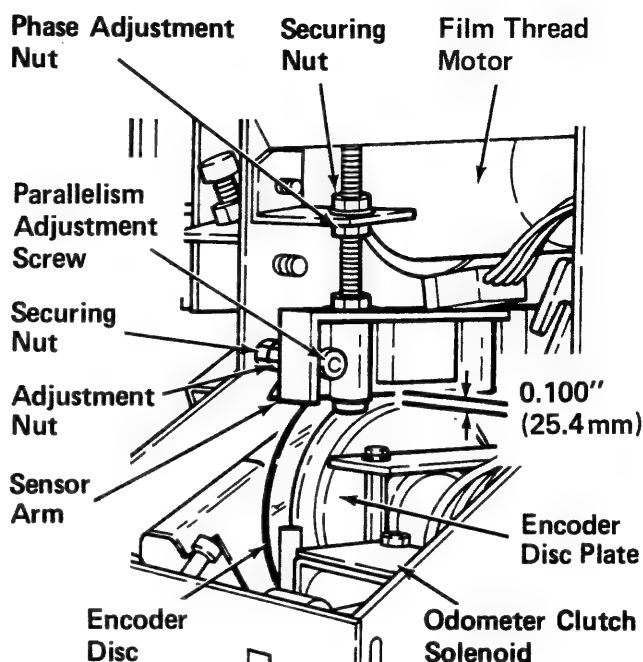


Figure 3-10.6A

10. While slowly turning the Encoder Disc observe the Odometer/Diagnostic-Status Display. The Status Code should display as described in Table 1.

Table 1.

Code No.	Direction of Encoder Disc Rotation*	Status Display
17	Clockwise	17XX(decrease)
17	Counterclockwise	17XX(no change)
18	Clockwise	18XX(no change)
18	Counterclockwise	18XX(decrease)
19	Clockwise	19XX(increase)
19	Counterclockwise	19XX(decrease)

* Viewed from front of machine.

11. Turn the Speed Control to Diagnostic Code 18 and repeat Step 10.
12. Turn the Speed Control to Diagnostic Code 19 and repeat Step 10.

13. Lift the Odometer Idler Roller and spin the Roller. It should rotate freely for at least 5 seconds and there should be no rubbing sound.

Parallelism Adjustment

1. Loosen the Securing Nut for the Phase Adjustment Screw (Figure 3-10.6A).
2. Loosen the Securing Nut for the Parallelism Adjustment Screw and, while holding the Adjustment Nut, turn the Parallelism Adjustment Screw (Figure 3-10.6A) so that the Encoder Disc is parallel with the Odometer Sensor Slot and as close to the rear as possible without touching (Figure 3-10.6B).

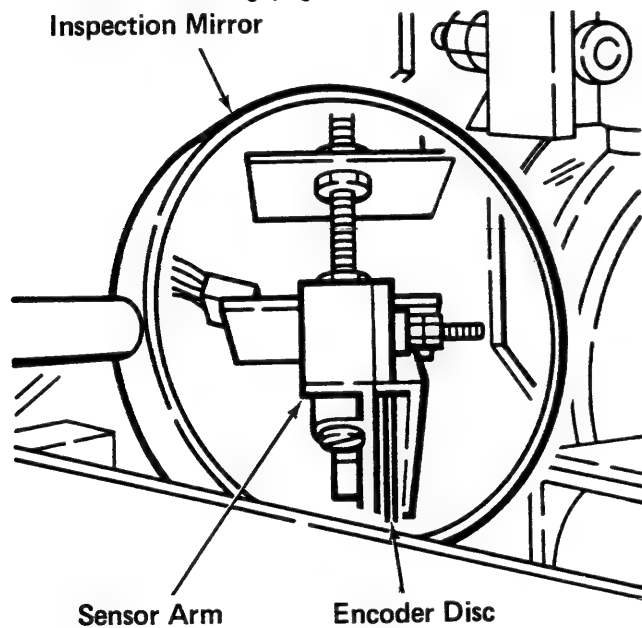


Figure 3-10.6B

Amplitude Adjustment

1. Turn the Film Speed Control to Diagnostic Code 38.
2. Momentarily press the Reset Button and turn the Film Speed Control fully counterclockwise to a 00 Status Code.
3. Turn the Film Speed Control clockwise to Status Code 08.

4. Press and hold the Reset Button to actuate the Swing Motor (M4) to make the Amplitude Adjustment Screw (Figure 3-10.6E) accessible.
5. Set the Oscilloscope controls as shown in Figure 3-10.6C.

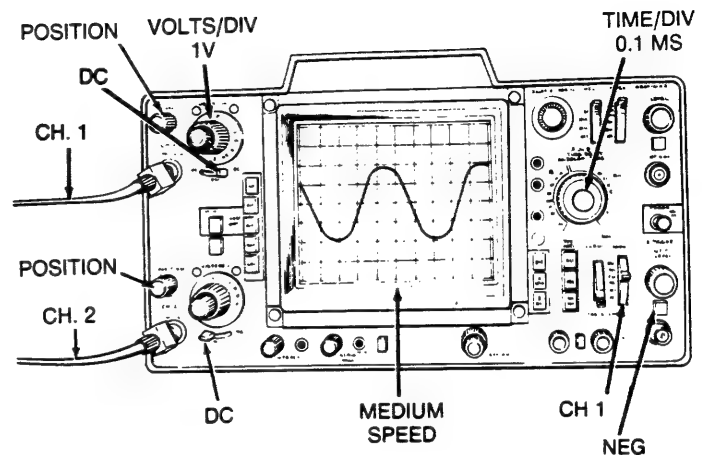


Figure 3-10.6C

6. Connect the Channel 1 Scope Probe to TP201 on the Peripheral PWA and the Channel 1 Ground to TP131 on the Processor PWA (Figure 3-10.6D).
7. Connect the Channel 2 Scope Probe to TP220 on the Peripheral PWA (Figure 3-10.6D). Do not connect the Channel 2 Ground.
8. Turn the Film Speed Control fully counterclockwise to Diagnostic Code 00 and press the Reset Button twice.

9. Turn the Film Speed Control clockwise to Diagnostic Code 43 and press the Reset Button.
10. Manually push in the plunger of the Odometer Clutch Solenoid (Y4), and keep it engaged by wrapping a rubberband around the Plunger and Glass Plate Bracket.

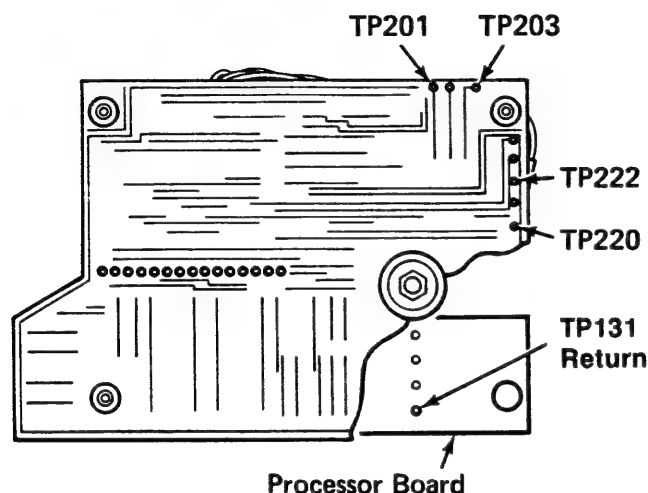


Figure 3-10.6D

10. Turn the Film Speed Control fully counterclockwise for a 4300 Status Code.
11. Turn the Film Speed Control fully clockwise for a 4399 Status Code.
12. Push the Reset Button to actuate the Film Thread Motor (M3) to turn the Encoder Disc.

Note

The following procedure may be done with the Reset Button taped down to free both hands.

13. While holding the Lock Nut, turn the Amplitude Adjustment Screw, (Figure 3-10.6E) for a greater than 3 Vpp display on the scope (Figure 3-10.6F) and no distortion at top and bottom of sine wave.

Note

The Channel 1 and Channel 2 amplitudes need not be the same but should be within spec.

14. Turn the Film Speed Control counterclockwise to 4310. Listen and ensure that the disc is not rubbing the sensor.

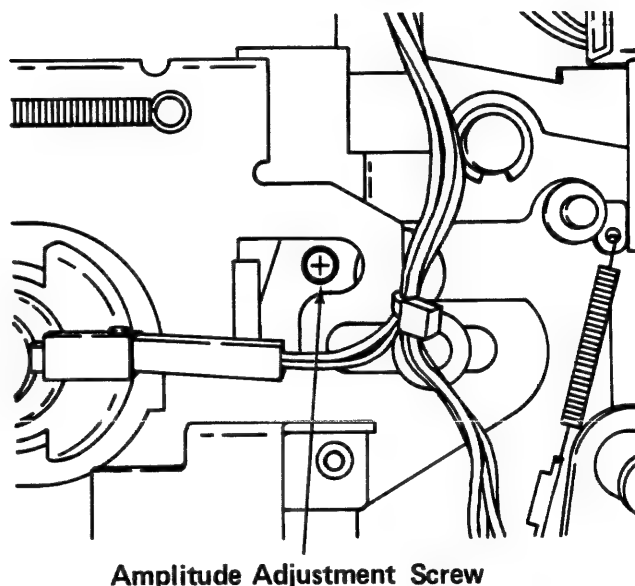


Figure 3-10.6E

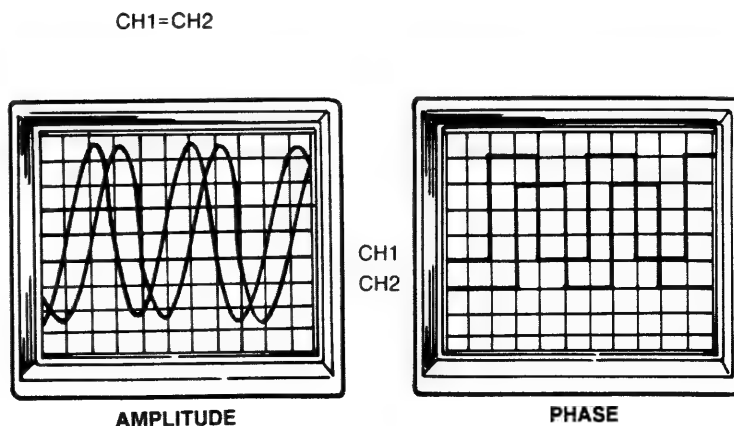


Figure 3-10.6F

14. Release the Reset Button to stop driving the Encoder Disc.
15. Repeat the Parallelism Adjustment to ensure parallelism has been maintained.

Phase Adjustment

1. Connect the Channel 1 Scope Probe to TP203 on the Peripheral PWA and Ground to TP131 on the Processor PWA (Figure 3-10.6D).
2. Connect the Channel 2 Scope Probe to TP222 on the Peripheral PWA (Figure 3-10.6D).
3. Press and hold the Reset Button to drive the Encoder Disc.

Note

The following procedure may be done with the Reset Button taped down to free both hands.

4. While holding the Securing Nut, turn the Phase Adjustment Nut (Figure 3-10.6A) for a 90° phase relationship (Figure 3-10.6F).
5. Release the Reset Button.
6. Switch the Service Switch On leaving the Scope Probes attached.
7. Insert a Film Cartridge.
8. Turn the Film Speed Control fully clockwise. Observe on the scope that the square waves should NEVER be in phase. See Figure 3-10.6F.
9. Turn the Film Speed Control fully counterclockwise. If the square waves meet, readjust the Phase Angle.
10. Switch ON the Service Switch to exit the Diagnostic Mode.

3-10.7. Leader Sense Switch (S8)

Symptoms

3M splicing tab does not stop on or to right of glass flats
Error Code X080

Specification

The Leader Sense Switch (S8) should actuate when a 3M Film Leader depresses the switch arm and deactuate when the arm is released.

Special Tools

Voltmeter

Measurement

1. Switch OFF the Reader-Printer.
2. Disconnect and remove the M-654 (210 CAT Operating Instructions).
3. Remove the Right Front Cover (Disassembly 4-2.1, page 4-1).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Remove the Top Right Cover (Disassembly 4-2.5, page 4-3).
6. Reconnect the M-654 and switch ON the Reader-Printer.
7. Load a 3M Test Cartridge.
8. Connect the Black Lead of a Voltmeter to the Common Terminal (left) of the Leader Sense Switch (S8). See Figure 3-10.7A.
9. Connect the Red Lead of a Voltmeter to the Normally Open Terminal (middle) of the Leader Sense Switch (S8). See Figure 3-10.7A.
10. While turning the Manual Scan Control, observe the Voltmeter. The Voltmeter should read 0 vdc when the film leader depresses the arm of the Leader Sense Switch (S8) and approximately 5 vdc when the arm is deactuated.

Note

Sixteen millimeter film should not touch the Actuator of the Leader Sense Switch (S8) during normal film movement.

Adjustment

Note

Do Film Chute Out Gap Adjustment Procedure 3-7 before proceeding.

1. Loosen the Adjustment Screws (Figure 3-10.7A and adjust the Leader Sense Switch (S8) so that when the switch arm is depressed by the film leader the Voltmeter reads 0 vdc, and when the switch arm is deactuated the voltmeter reads approximately 5 vdc.
2. Tighten the Adjustment Screws and repeat Measurement Step 10.

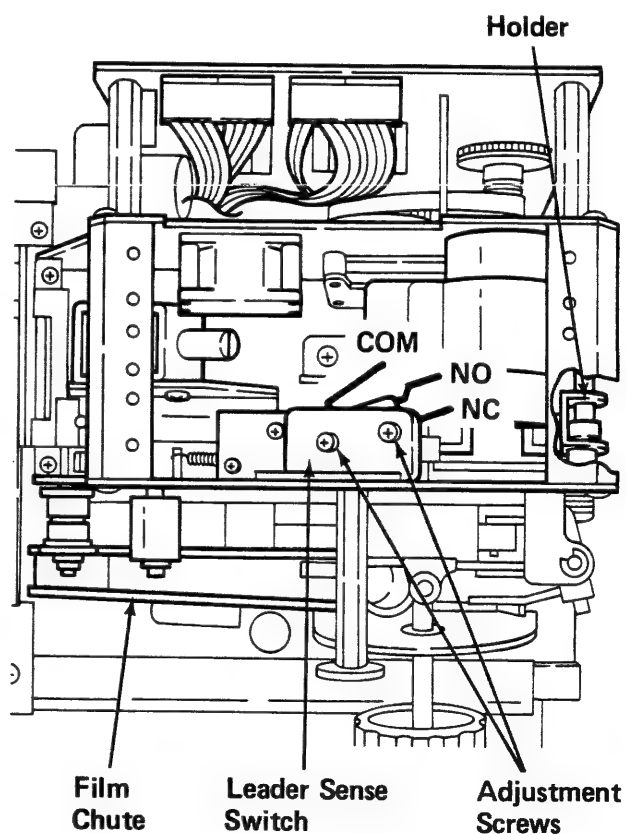


Figure 3-10.7A

3-10.8. Film Chute In Switch (S9)**Symptoms**

Error Code X006, X709, X009, X397

Specification

The Film Chute In Switch (S9) should be actuated when the Film Chute is in and deactuated when the Film Chute is out.

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Front Right Cover (Disassembly 4-2.2, page 4-1).
5. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
6. Remove the Top Right Cover (Disassembly 4-2.5, page 4-3).
7. Switch the Service Switch OFF.
8. Reconnect the M-654 and switch ON the Reader-Printer.
9. Turn the Film Speed Control to Diagnostic Code 09. The Status Code should read 0.
10. Push in on the top of the Anti-Static Roller Pivot (Figure 3-10.8A) and manually push the Film Chute all the way in. The Status Code should read 1.

Adjustment

1. Loosen the Adjustment Screws for the Film Chute In Switch (S9) (Figure 3-10.8A).
2. Push in on the top of the Anti-Static Roller Pivot and manually push the Film Chute in.

3. Move the Film Chute In Switch (S9) to the front until the Status Code changes to 1 and tighten the Adjustment Screws.

Note

The switch should actuate with 0.8 mm (0.032 in.) minimum travel remaining.

4. Repeat Measurement Step 10.
5. Check Film Chute Out Switch (S10) (Adjustment 3-10.9, page 3-24).
6. Switch ON the Service Switch to exit the Diagnostic Code.

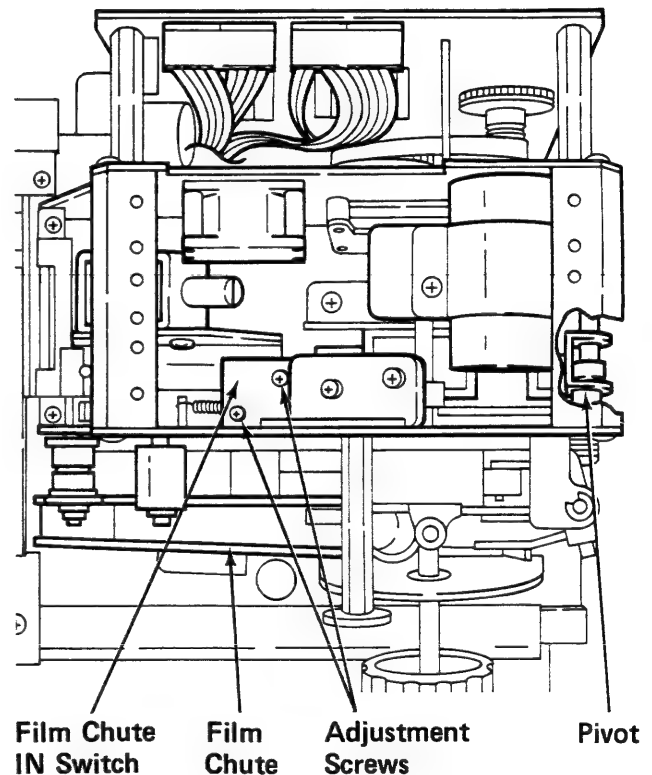


Figure 3-10.8A

3-10.9 Film Chute Out Switch (S10)

Symptoms

Error Code X006, X010, X710, X398

Specification

The Film Chute Out Switch (S10) should be actuated when the Film Chute is out and deactivated when the Film Chute is in.

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Front Right Cover (Disassembly 4-2.2, page 4-1).
5. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
6. Remove the Top Right Cover (Disassembly 4-2.5, page 4-3).
7. Switch the Service Switch OFF.
8. Reconnect the M-654 and switch ON the Reader-Printer.
9. Turn the Film Speed Control to Diagnostic Code 10. The Status Code should read 1.
10. Manually push the Film Chute in. The Status Code should read 0.

Adjustment

1. Loosen the Adjustment Screws for the Film Chute Out Switch (S10) (Figure 3-10.9A).
2. Push in on the Film Chute Out Switch (S10) until the Status Code changes to 1 and tighten the Adjustment Screws.

Note

The switch should actuate with 0.5 mm (0.032 in.) minimum travel remaining.

3. Repeat Measurement Steps 9 and 10.
4. Switch ON the Service Instructor to exit the Diagnostic Mode.
5. Check Film Chute In Switch (S9) Adjustment 3-10.8, page 3-23.

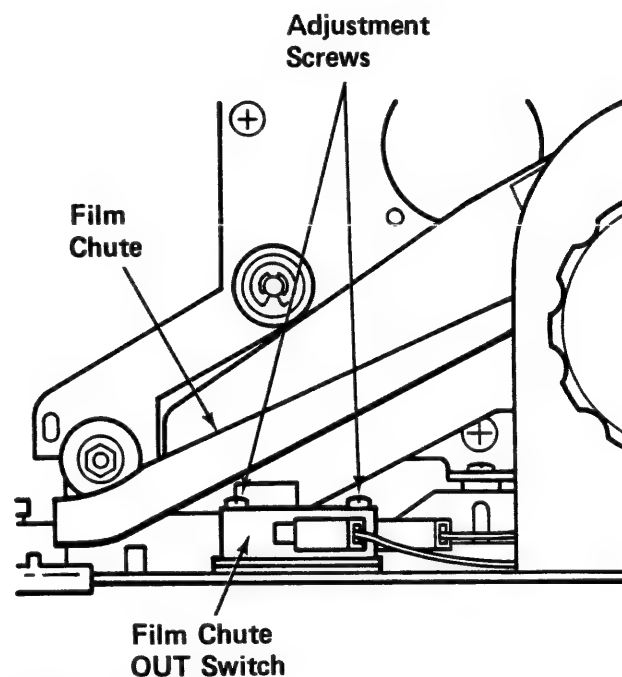


Figure 3-10.9A

3-10.10. Advance Motor Speed Sensor (S11)**Symptoms**

Film does not slow down during rewind/eject cycle
 3M leader wedges in reel during rewind/eject cycle

Specification

The Advance Motor Speed Sensor (S11) should switch on and off when the Advance Drive Motor Shaft is turned.

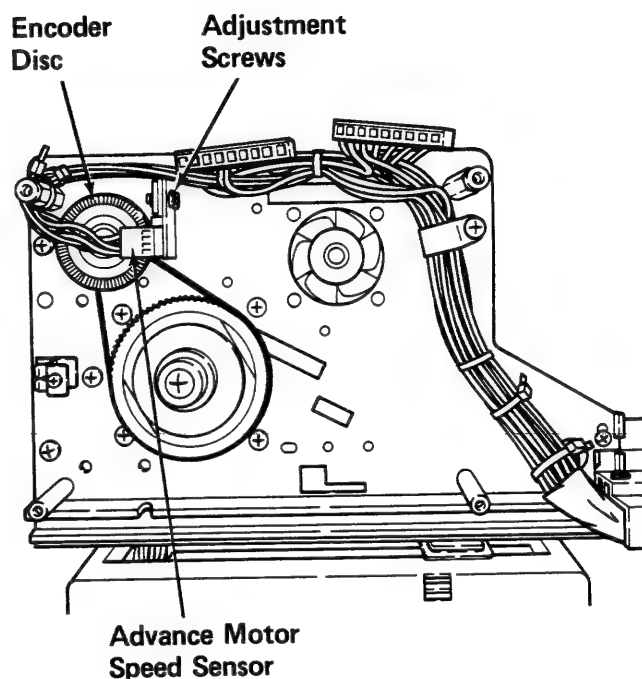
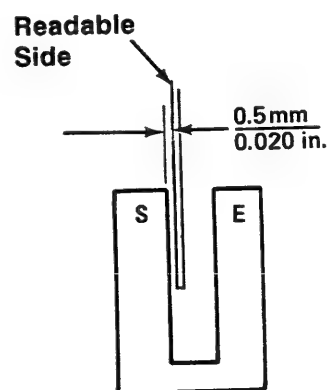
Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Remove the Top Right Cover (Disassembly 4-2.5, page 4-3).
6. Switch the Service Switch OFF.
7. Reconnect the M-654 and switch ON the Reader-Printer.
8. Turn the Film Speed Control to a Diagnostic Code of 11. The Status Code will display a 0 or a 1.
9. Turn the Manual Scan Control either direction very slowly. The Status Code should alternate 0 and 1.
10. Ensure the Advance Motor Speed Encoder Disc does not touch the Advance Motor Speed Sensor (S11).

Adjustment

1. Remove the Power PWA (Disassembly 4-3.1, page 4-4).
2. Loosen the Adjustment Screws for the Advance Motor Speed Sensor (Figure 3-10.10A).

3. Position the Encoder Disc for the Advance Motor Speed Sensor about 0.5mm (0.020 in.) from the "S" side of the sensor (Figure 3-10.10B) and about half-way from the bottom of the U-slot.
4. Repeat Measurement Steps 9 and 10.
5. Switch ON the Reader-Printer to exit the Diagnostic Mode.

**Figure 3-10.10A****Figure 3-10.10B**

3-10.11. Cartridge Manual Eject Switch (S12)**Symptoms**

Unable to eject jammed cartridge with Error Code 3XXX

Specifications

The Cartridge Manual Eject Switch (S12) should switch when the Eject Bracket Cartridge Manual is moved 1.5 mm to 2.0 mm (0.059 in. to 0.079 in.) to the rear.

Note

On newer M-654's (with Blue Lever) the switch should deactuate. On older M-654's (without Blue Lever) the switch should actuate.

Special Tools

Ruler

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Remove the Top Left Cover (Disassembly 4-2.4, page 4-2).
6. Switch the Service Switch OFF.
7. For **Newer** (Blue Lever) units, turn the Film Speed Control to Diagnostic Code 12. The Status Code should read 1.
8. For **Older** (no Blue Lever) units, turn the Film Speed Control to Diagnostic Code 4 and insert a cartridge. The status code should read 1. Place a Ruler on the left side of the machine and push the Bracket 1.5 mm to 2.0 mm (0.059 in. to 0.079 in.). See Figure 3-10.11A. The Status Code should change to 0.

Adjustment

1. Loosen the Adjustment Screws for the Cartridge Manual Eject Switch (S12) and reposition as required. See Figure 3-10.11A.
2. Repeat Measurement Steps 7 and 8.

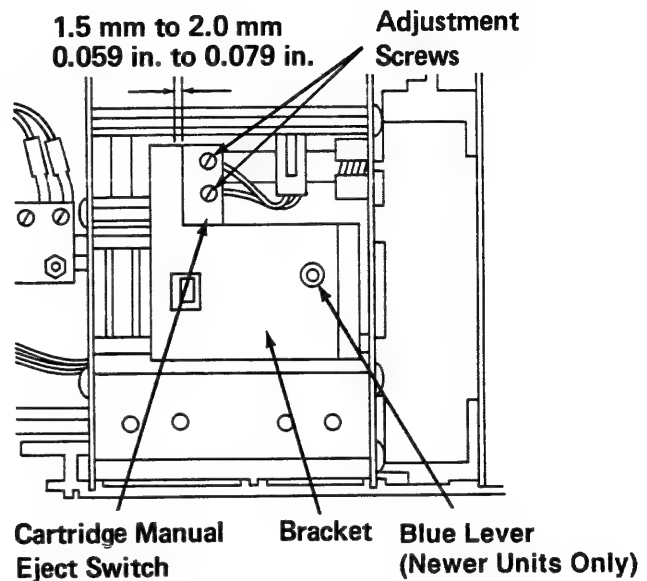


Figure 3-10.11A

3.11 FILM TRAVERSE

Symptoms

Turning Film Traverse Control does not move
Film Transport
Transport moves in an erratic manner while
turning Film Traverse Control

Specification

The Base should move to the rear when the Traverse Control is turned clockwise (raise screen image) and to the front when turned counterclockwise (lower screen image).

Measurement

1. Turn the Traverse Control clockwise. The Base should move to the rear (screen image raises).
2. Turn the Traverse Control counterclockwise. The Base should move to the front (screen image lowers).

Adjustment

1. Switch ON the Reader-Printer, rewind Film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Bottom Cover (Disassembly 4-2.6, page 4-3).
5. Loosen the Adjustment and Pivot Screws (Figure 3-11A).
6. Move the Gear Bracket to the left to tighten the Drive Belt or to the right to loosen the Drive Belt.
7. Tighten the Adjustment Screws.
8. Repeat Measurement Steps 1 and 2.

Adjustment
and Pivot Screws

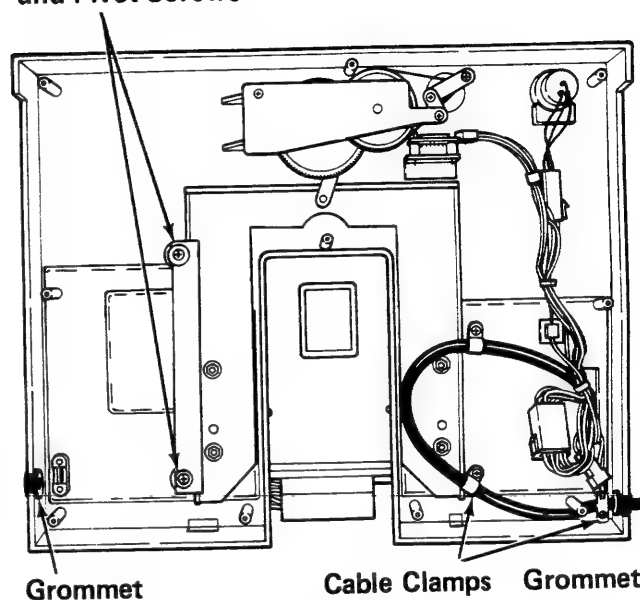


Figure 3-11A

3-12. FILM THREADING BALL

Symptoms

Incomplete auto-thread

Specification

The Film Threading Ball must just touch the Film Take-Up Reel and the Film Chute must pull in when the Film Chute Solenoid (Y6) is energized at a diagnostic voltage level of 05.

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Remove the Front Left Cover (Disassembly 4-2.1, page 4-1).
4. Remove the Front Right Cover (Disassembly 4-2.2, page 4-1).
5. Pull the Anti-Static Roller away from the Film Take-Up Reel and push the Film Chute in. The Film Threading Ball should move smoothly onto the Take-Up Reel with very little resistance.
6. Holding the Film Chute in, manually thread a leader up the Film Chute. The Film Threading Ball should prevent the leader from advancing.
7. Switch OFF the Service Switch.
8. Reconnect the M-654 and switch ON the Reader-Printer.
9. Turn the Film Speed Control to Diagnostic Code 36.
10. Turn the Film Speed Control fully counterclockwise to a 00 Status Code then clockwise to 05.
11. Press the Reset Button to actuate the Film Chute Solenoid (Y6). The Film Chute should pull in properly.

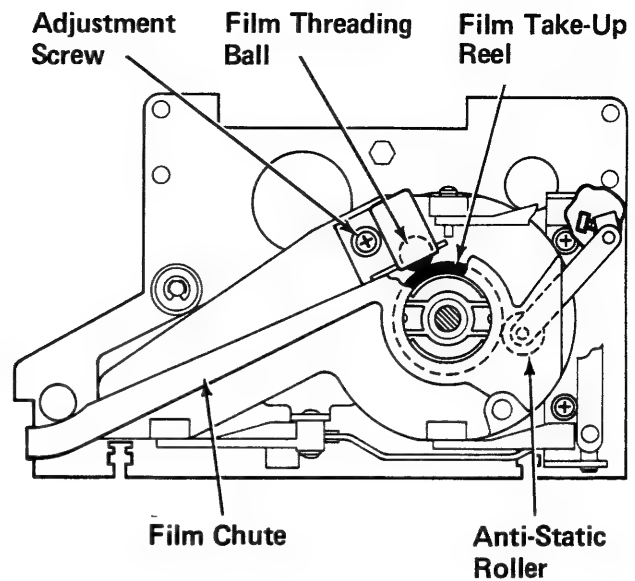
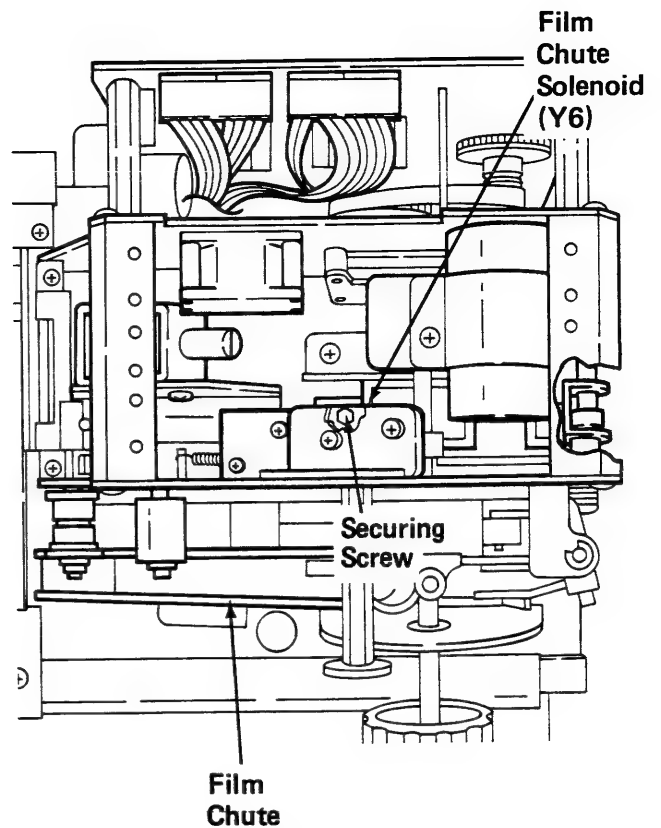


Figure 3-12A

Adjustment

1. Loosen the Adjustment Screw (Figure 3-12A) and raise the Film Threading Ball Assembly to its highest position.
2. Pull the Anti-Static Roller away from the Take-Up Reel and push the Film Chute in.
3. Lightly push the Film Threading Ball Assembly down against the Take-Up Reel and tighten the Adjustment Screw.
4. Repeat Measurement Steps 5 and 6.
5. Loosen the Securing Screw securing the Chute Solenoid (Y6) to the Film Chute Linkage (Figure 3.12B).
6. Allow the linkage to relax to its own position.
7. Tighten the Securing Screw.
8. Repeat Measurement Step 11.
9. Switch ON the Service Switch to exit the Diagnostic Mode.

**Figure 3-12B**

3-13. ANTI-STATIC ROLLER

Symptoms

Error Code 1002
Erratic, strange and intermittent electrical problems
Film Chute does not close during loading

Specification

The Anti-Static Roller should contact film.

Measurement

1. Remove the Front Right Cover (Disassembly 4-2.2, page 4-1).
2. Switch ON the Reader-Printer and load a Test Cartridge.
3. Ensure the Anti-Static Roller is touching the film.

Adjustment

1. Switch OFF the Reader-Printer.
2. Disconnect and remove the M-654 (210 CAT Operating Instructions).
3. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
4. Remove the Top Right Cover (Disassembly 4-2.5, page 4-3).
5. Loosen the Adjustment Screw (Figure 3-13A).
6. Press the Anti-Static Roller against the film and tighten the Adjustment Screw.

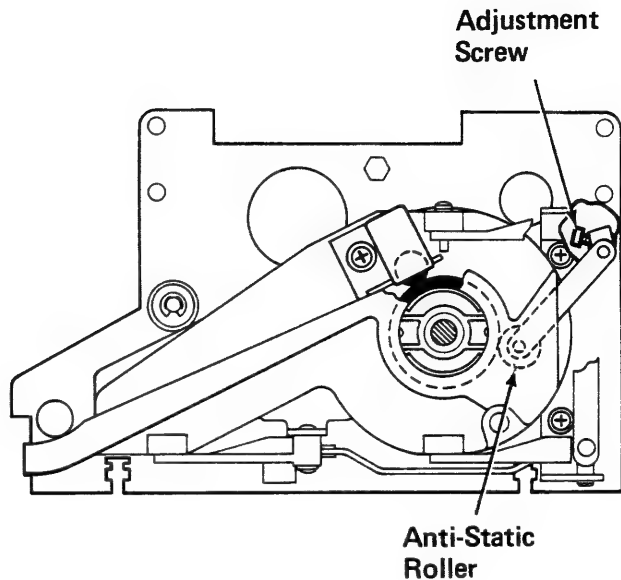


Figure 3-13A

3-14. FILM PRESSURE GUIDE ROLLER

Symptoms

Incomplete auto-thread
ANSI film mistracks during scan

Specification

The Film Pressure Guide Roller should be adjusted so that a Film Cartridge will not be ejected after the loading sequence, and that film tracks properly and does not drive erratically.

Special Tools

Adjustment tool 78-8060-7363-7

Measurement

1. Remove the Left Front Cover (Disassembly 4-2.1, page 4-1).

Note

The Adjustment Screw should extend approximately 6.35 mm (0.25 in.) within the Pressure Spring.

2. Place the D dimension 22.8 mm (0.898 in.) of the Adjustment Tool between the Top of the Holder for the Film Pressure Guide Roller and the top of the Adjustment Nut (Figure 3-14A). The top of the Adjustment Nut and the top of the gauge should be in the same plane.

Adjustment

1. Loosen the Securing Nut and turn the Adjustment Screw clockwise to lower the Adjustment Nut increasing the spring pressure or counter-clockwise to raise the Adjustment Nut decreasing the spring pressure.
2. Tighten the Securing Nut.
3. Repeat Measurement Step 2.

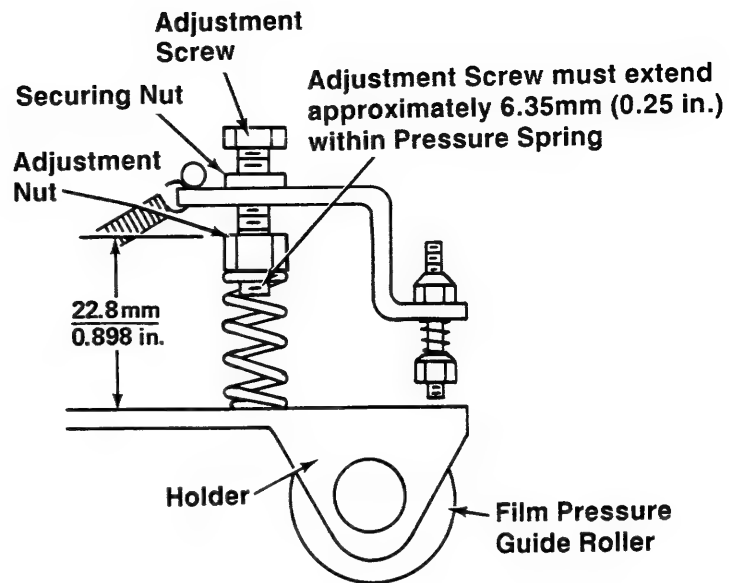
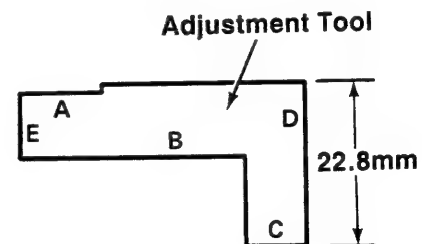


Figure 3-14A



3-15. AUXILIARY NIP PRESSURE

Symptoms

Incomplete auto-thread
ANSI film mistracks during scan

Specification

The Film Pressure Guide Roller should be adjusted so that pressure is increased on the Leader during loading by adjusting the Adjustment Screw for a gap of 0.254mm (0.010 in.) and the Adjustment Nut for a gap of 8.33 mm (0.328 in.) from the bottom of the nut to the Nip Bracket.

Special Tools

Adjustment Tool 78-8060-7363-7

Measurement

1. Remove the Left Front Cover (Disassembly 4-2.1, page 4-1).
2. Insert a 0.254 mm (0.010 in.) Feeler Gauge between the Adjustment Screw and the top of the Holder for the Film Pressure Guide Roller (Figure 3-15A). The gauge should be able to slip with some resistance.
3. Place the E dimension 8.3 mm (0.328 in.) of the Adjustment Tool between the bottom of the Adjustment Nut and the Nip Bracket (Figure 3-15A). The bottom of the Adjustment Nut and the gauge should be in the same plane.
4. Load a 3M Type Cartridge with a Leader. Observe the following:
 - a. With leader in the Nip there should be a gap between the Securing Nut and the Nip Bracket.
 - b. With film in the Nip there should be a gap between the Adjustment Screw and Holder for the Film Pressure Guide Roller.

Adjustment

1. Loosen the Securing Nut and turn the Adjustment Screw clockwise to lower the screw or counter-clockwise to raise the screw for a gap of 8.33 mm (0.328 in.) from the bottom of the nut to the Nip Bracket.
2. Tighten the Securing Nut.
3. Turn the Adjustment Nut clockwise to lower the nut increasing the spring pressure or counter-clockwise to raise the nut decreasing the spring pressure.
4. Repeat Measurement Steps 2, 3, and 4.

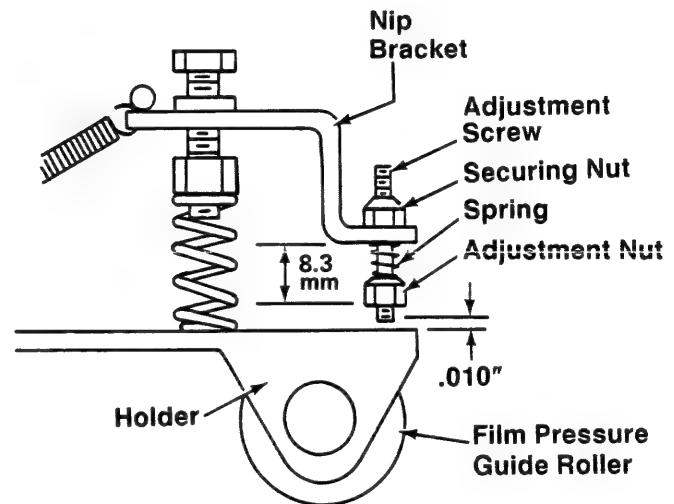
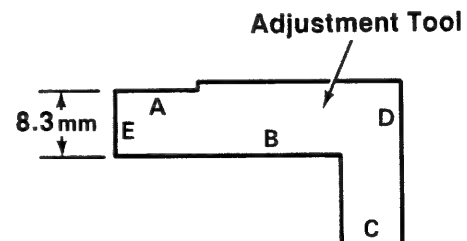


Figure 3-15A



3-16. STRIPPER POSITION**Symptoms**

Film does not come out of cartridge
 3M leader exits cartridge but does not reach
 Odometer Roller
 Puck wears out early
 Erratic thread-out problems
 Error Code X310, X311, X331

Specification

The Stripper should be positioned so that the leader of an ANSI Cartridge having only 1/3 of a roll of film will not stub on Guide III by being to the right of the Step. The stripper should not touch the Puck.

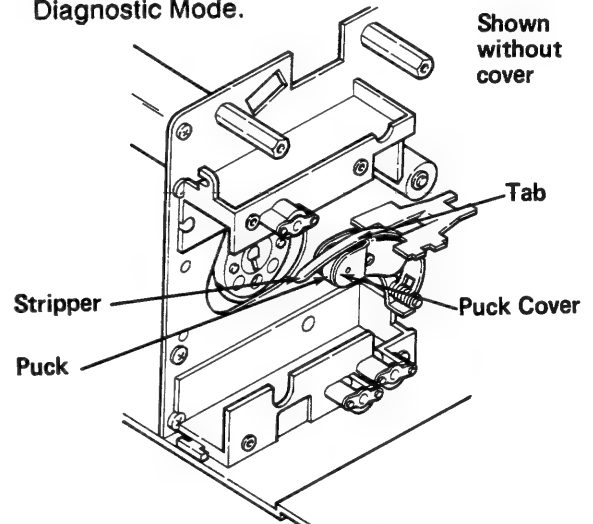
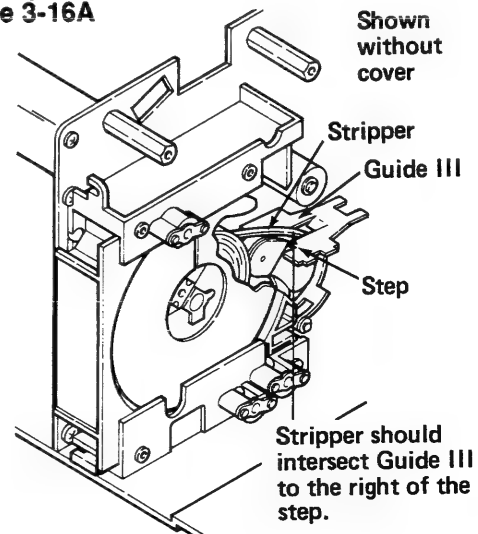
Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Remove the Front Left Cover (Disassembly 4-2.1, page 4-1).
6. Reconnect the M-654 and switch ON the Reader-Printer.
7. Switch OFF the Service Switch.
8. Turn the Film Speed Control to Diagnostic Code 38.
9. Momentarily press the Reset Button and turn the Film Speed Control fully counterclockwise to a 00 Status Code.
10. Turn the Film Speed Control clockwise to Status Code 08.
11. Press the Reset Button to activate the Swing Motor (M4) to drive the Stripper in.
12. Observe that the Stripper does not touch the Puck (Figure 3-16A).

13. Push in an ANSI Cartridge having only 1/3 of a roll of film and, while holding it in, observe that the Stripper intersects Guide III to the right of the step (Figure 3-16B).

Adjustment

1. If the Stripper touches the Puck, bend the Tab on the Puck Cover upward so that the Stripper does not touch the Puck (Figure 3-16A).
2. Bend the Stripper as required so that it intersects Guide III to the right of the step (Figure 3-16B).
3. Repeat Measurement Steps 12 and 13.
4. Switch ON the Service Switch the exit the Diagnostic Mode.

**Figure 3-16A****Figure 3-16B**

3-17. FILM CHUTE PIVOT BRACKET

Symptoms

Incomplete auto-thread
Film binds in take-up chute to prevent chute
from opening

Specification

The Film Chute Pivot Bracket should be 34.0mm (1.3 in.) from the top of the plate and 12.0mm (0.47 in.) from the right side of the plate.

Special Tools

Adjustment Tool 78-8060-7363-7

Measurement

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Remove the Front Right Cover (Disassembly 4-2.2, page 4-1).
4. Place the B dimension 34.0mm (1.3 in.) between the top of the Plate and top of the Holder (Figure 3-17A). The edges of the gauge should be in the same plane as the Plate and Roller.
5. Place the A dimension 12.0mm (0.47 in.) between the right edge of the Holder and right edge of the Plate. The edges of the Gauge and Holder should be in the same plane at top and bottom.

Adjustment

1. Loosen the Adjustment Screws (Figure 3-12A) and reposition the Holder as required.
2. Tighten the Adjustment Screws.
3. Repeat Measurement Steps 4 and 5.

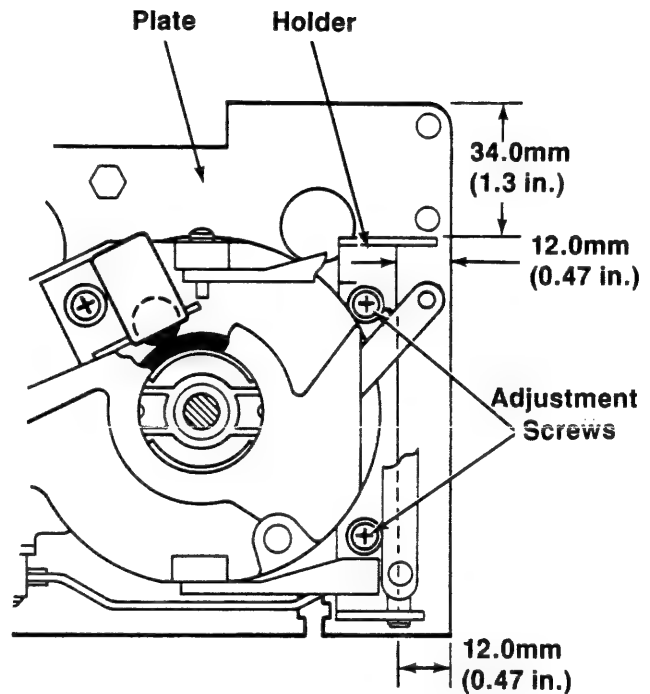


Figure 3-17A

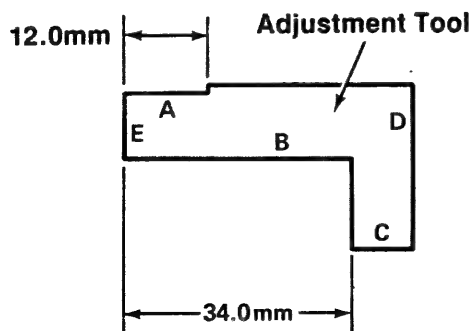


Figure 3-17

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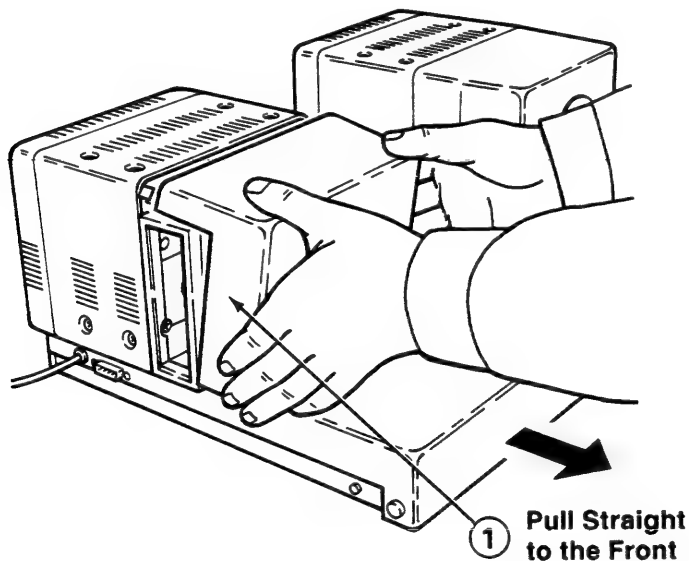
4-1. GENERAL

The disassembly procedures in this section are illustrated views with a minimum of supporting text. The order of disassembly is indicated numerically with 1 being the first step, 2 the second step, and so on. Assembly is in the reverse order of disassembly.

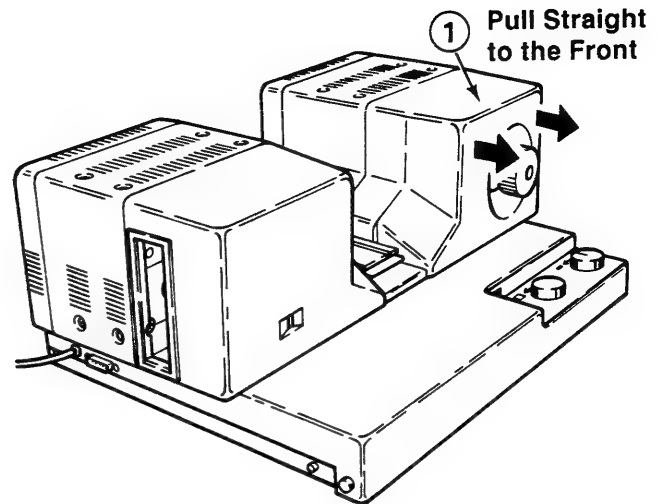
Review and understand each procedure carefully before disassembly of any component. Disassembly Procedures in parentheses are given as a reference if needed.

4-2. EXTERNAL COVERS

4-2.1. Front Left Cover

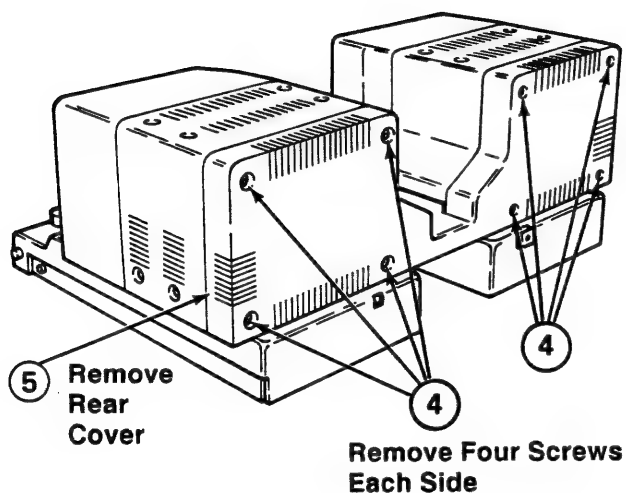


4-2.2. Front Right Cover



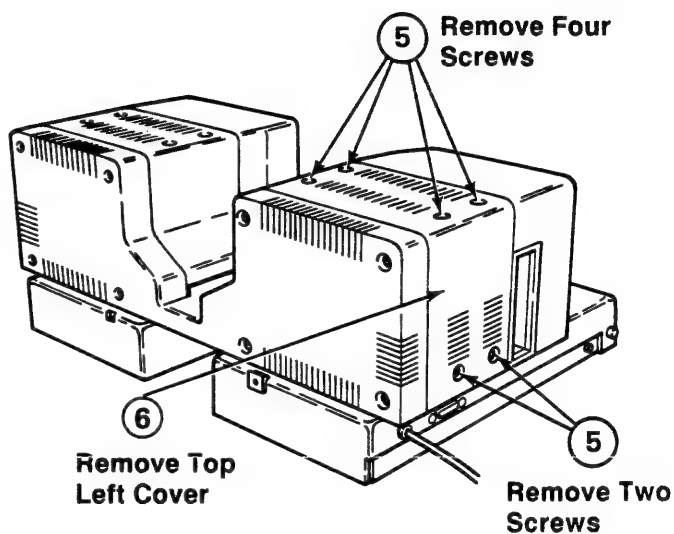
4-2.3. Rear Cover

1. Unload film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).



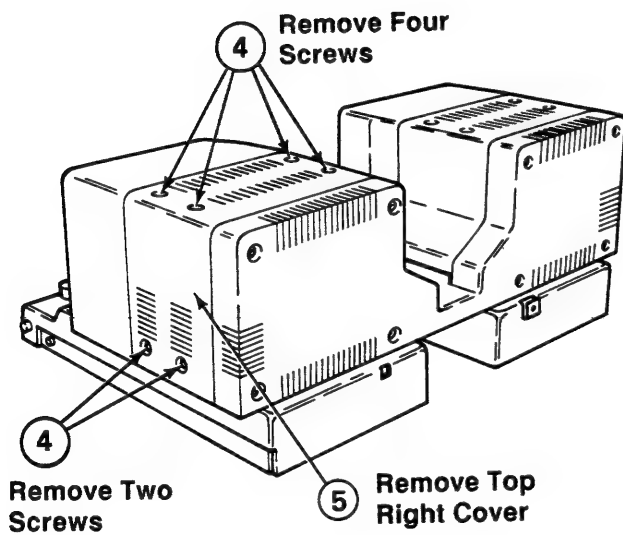
4-2.4. Top Left Cover

1. Unload film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).



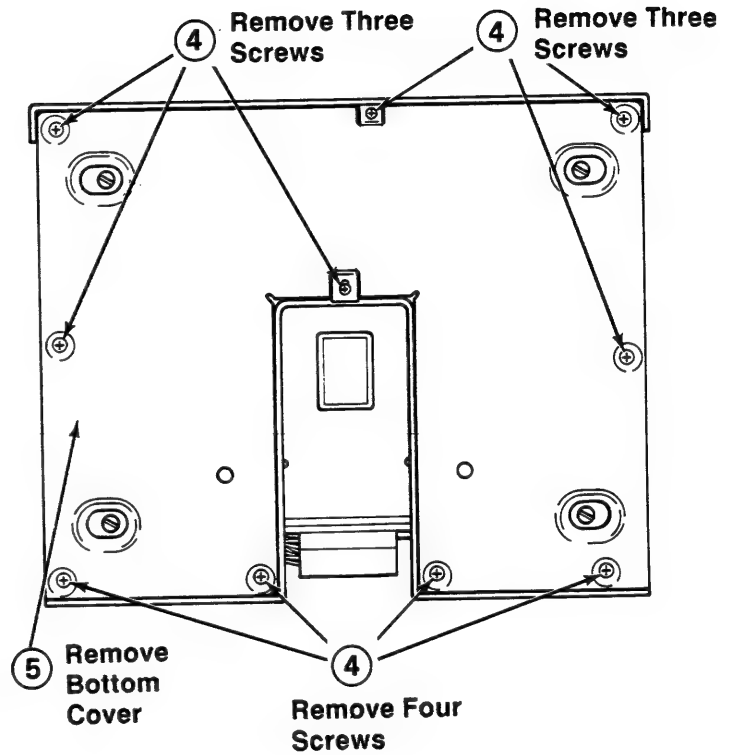
4-2.5. Top Right Cover

1. Unload film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).



4-2.6. Bottom Cover

1. Unload film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).



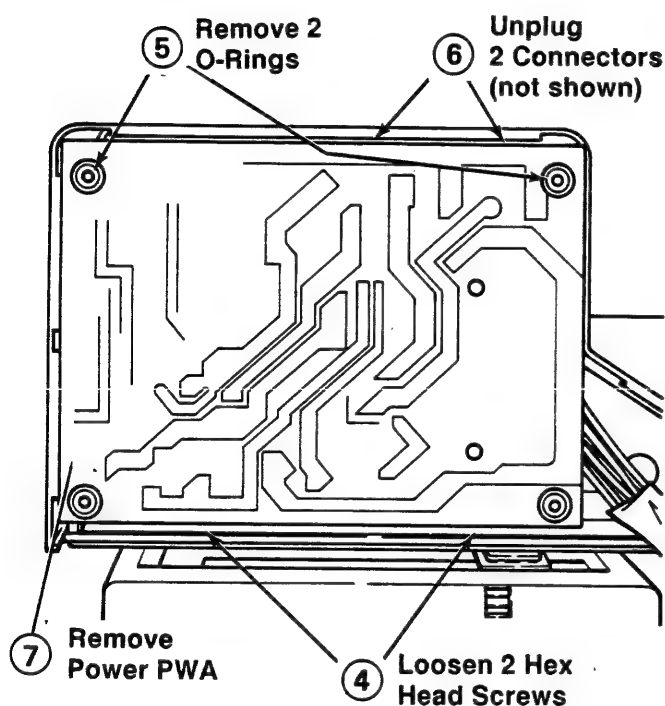
6. Disconnect the Ground Strap (not shown).

4-3. ELECTRICAL COMPONENTS

4-3.1. Power PWA

1. Unload film and switch OFF the Reader-Printer.
2. Remove the M-654 (210 CAT Operating Instructions).
3. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).

CAUTION
Use Static Wrist Strap.



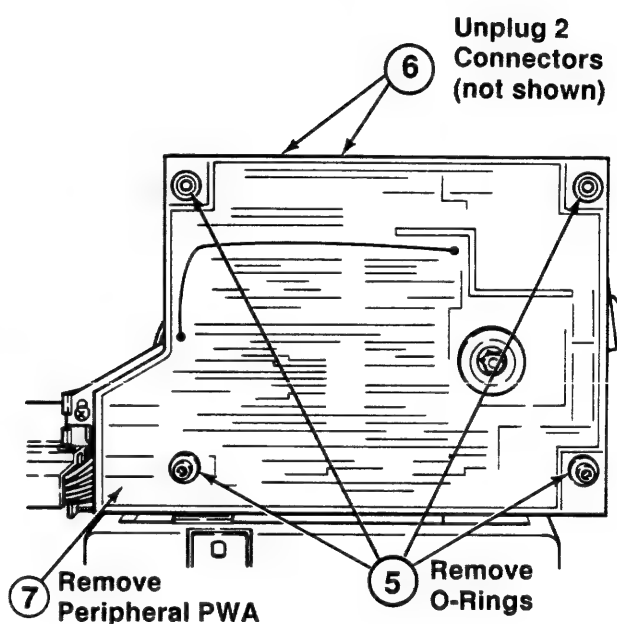
Note

Before Reassembly, coat the Heat Sink with Wakefield Heat Transfer Compound (78-8931-7001-5).

4-3.2 Peripheral PWA

1. Unload film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).

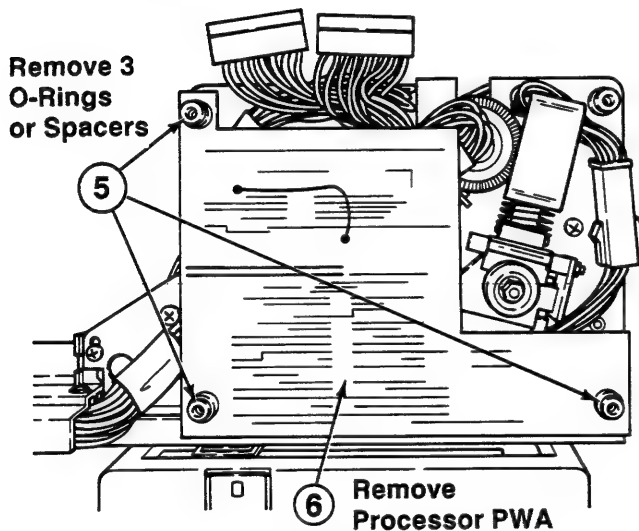
CAUTION
Use Static Wrist Strap.



4-3.3. Processor PWA

1. Unload film and switch OFF the Reader-Printer.
2. Remove the M-654 (210 CAT Operating Instructions).
3. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
4. Remove the Peripheral PWA (Disassembly 4-3.2, page 4-4).

CAUTION
Use Static Wrist Strap.

**4-3.4. Encoder Disc**

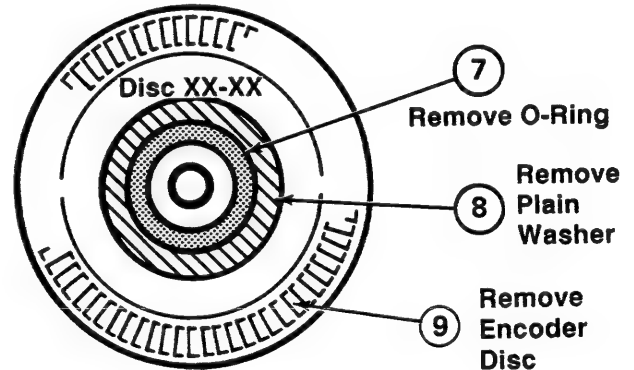
1. Unload film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).

Film Reverse Motor

5. Remove the Top Left Cover (Disassembly 4-2.4, page 4-2).
6. Remove the Peripheral PWA (Disassembly 4-3.2, page 4-4) and Processor PWA (Disassembly 4-2.3, page 4-2).

Film Advance Motor

5. Remove the Top Right Cover (Disassembly 4-2.5, page 4-3).
6. Remove the Power PWA (Disassembly 4-3.1, page 4-4).

**Note**

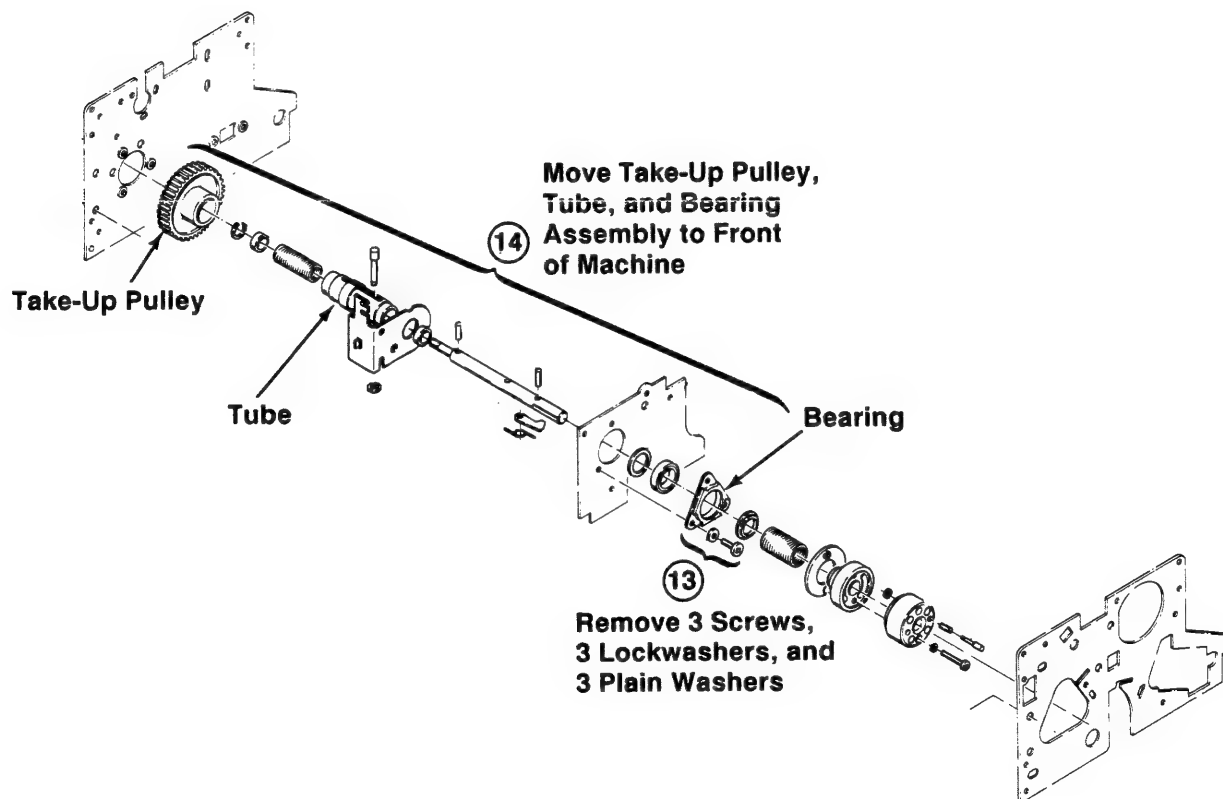
Before installing a new Encoder Disc, peel off the protective Mylar Cover.

Reassembly Tips:

1. The readable side of the Motor Encoder Disc should face the "S" side of the Encoder Sensor.
2. Moisten the O-Ring for easier installation and better seating.

4-4. MOTORS AND DRIVE BELTS**4-4.1 Film Reverse Motor and Drive Belt**

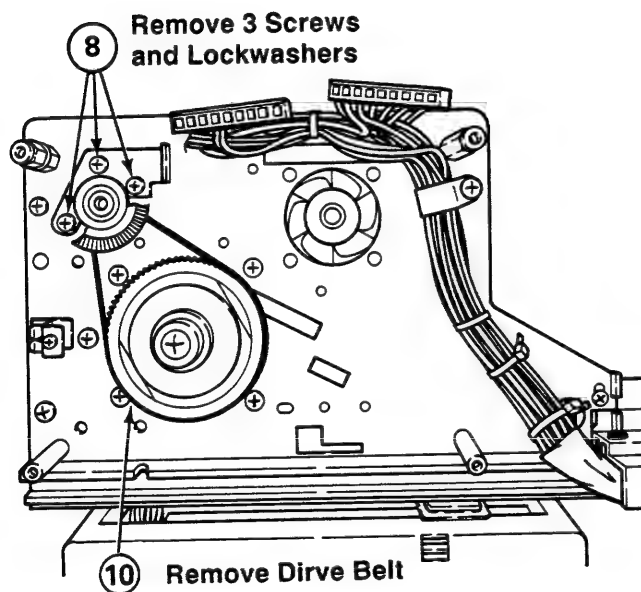
1. Unload film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).
4. Remove the Front Left Cover (Disassembly 4-2.1, page 4-1).
5. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
6. Remove the Top Left Cover (Disassembly 4-2.4, page 4-2).
7. Remove the Peripheral PWA (Disassembly 4-3.2).
8. Remove the Processor PW (Disassembly 4-3.3).
9. Remove the encoder disc from the film reverse motor (See illustration on page 4-5).
10. Remove the Film reverse motor (three mounting screws).
11. Remove the ANSI Flange (Disassembly 4-7, page 4-11).
12. Do all of Lever (Pawl) Disassembly procedure 4-8, page 4-12 except steps 16 and 17.



15. Remove Drive Belt (not shown).

4-4.2 Film Advance Drive Belt

1. Unload film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Remove the Top Right Cover (Disassembly 4-2.5, page 4-3).
6. Remove the Power PWA (Disassembly 4-3.1, page 4-4).
7. Remove the Motor Encoder Disc (Disassembly 4-3.3, page 4-5).



9. Unplug the Connector (not shown).

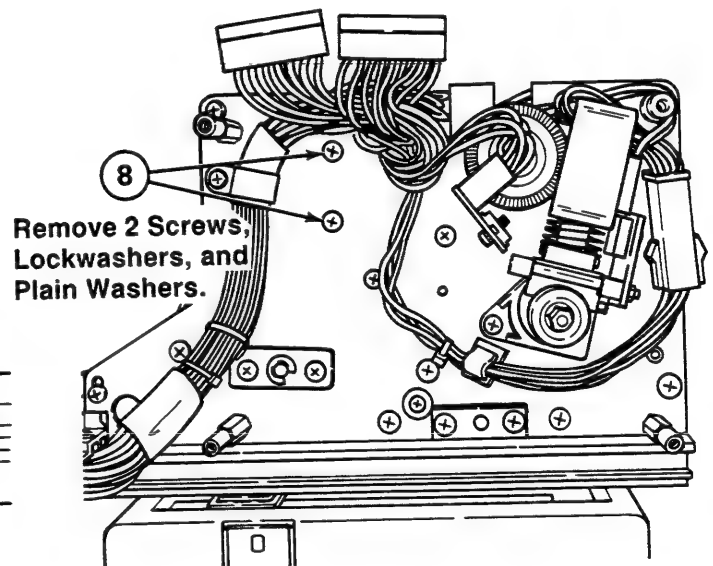
Note

Do Film Advance Motor Drive Belt Adjustment 3-9.2, page 3-11.

10. Remove Drive Belt.

4-4.3. Film Thread Motor and Drive Belt

1. Unload film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Remove the Top Left Cover (Disassembly 4-2.4, page 4-2).
6. Remove the Peripheral PWA (Disassembly 4-3.2, page 4-4).
7. Remove the Processor PWA (Disassembly 4-3.3, page 4-5).



9. Remove the Drive Belt (not shown).

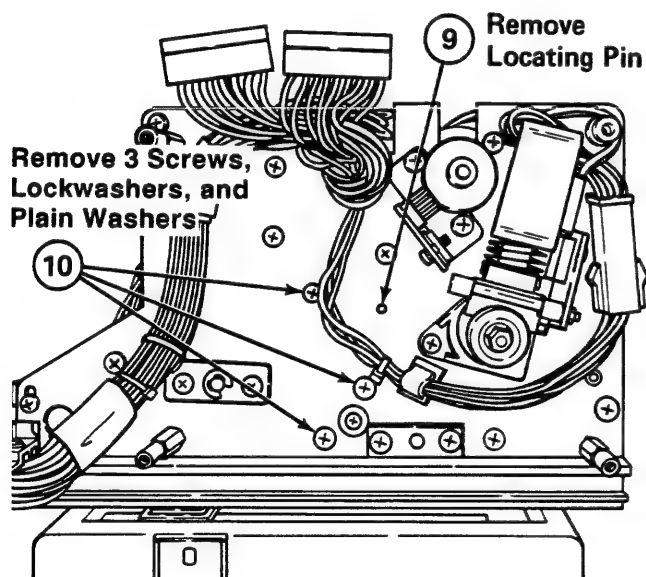
10. Unplug the Connector (not shown).

Note

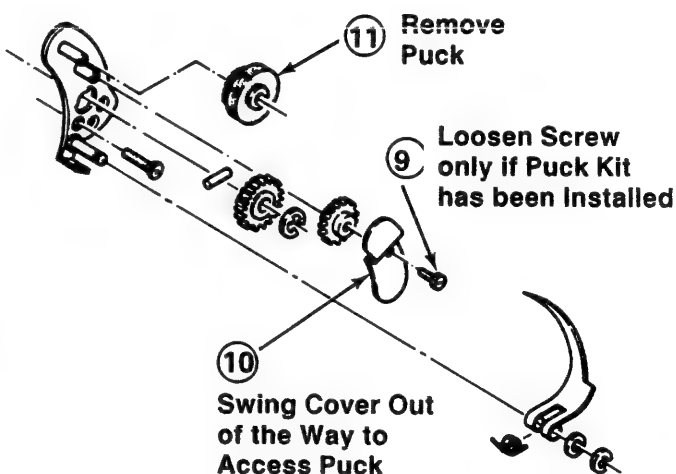
Do Film Thread Motor Drive Belt Adjustment 3-9.3, page 3-12.

4-4.4. Swing Motor Assembly

1. Unload film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).
4. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
5. Remove the Top Left Cover (Disassembly 4-2.4, page 4-2).
6. Remove the Peripheral PWA (Disassembly 4-3.2, page 4-4).
7. Remove the Processor PWA (Disassembly 4-3.3, page 4-5).
8. Remove the Film Thread Motor (Disassembly 4-4.3, page 4-7).

**4-5. PUCK**

1. Unload film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).
4. Remove the Front Left Cover (Disassembly 4-2.1, page 4-1).
5. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
6. Remove the Top Left Cover (Disassembly 4-2.4, page 4-2).
7. Remove ANSI Flange (Disassembly 4-7, page 4-10).
8. Move Stripper Assembly IN by manually turning Swing Motor.



11. Unplug the Connector.

Note

If a Puck Kit (78-8060-7372-8) has not yet been installed, do so now for easier disassembly.

4-6. ODOMETER ENCODER DISC

1. Unload film and switch OFF the Reader-Printer.
2. Remove the M-654 (210 CAT Operating Instructions).
3. Remove the Front Left Cover (Disassembly 4-2.1, page 4-1).
4. Remove the Rear Cover (Disassembly 4-2.4, page 4-2).
5. Remove the Top Left Cover (Disassembly 4-2.4, page 4-2).

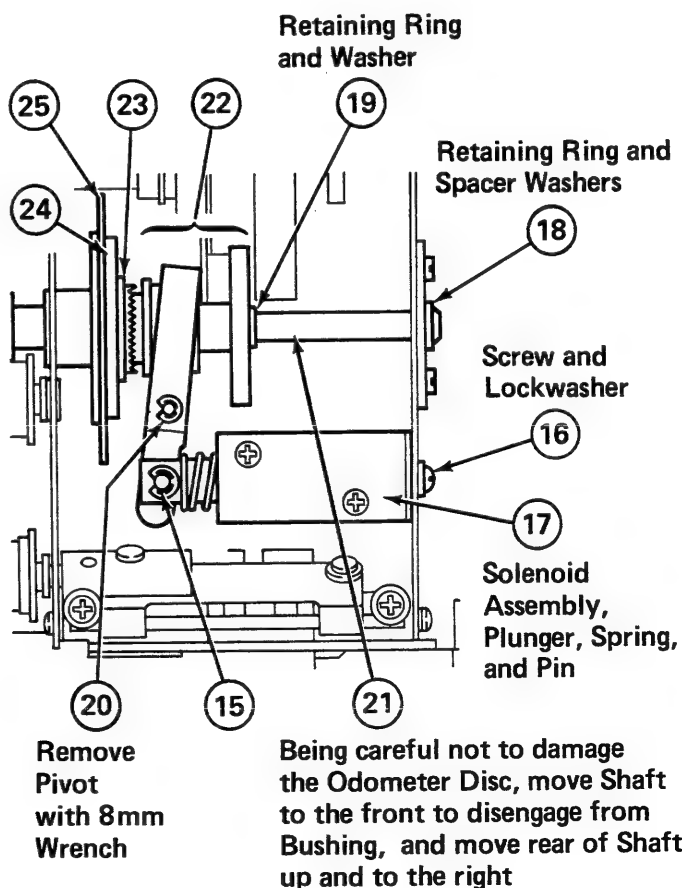
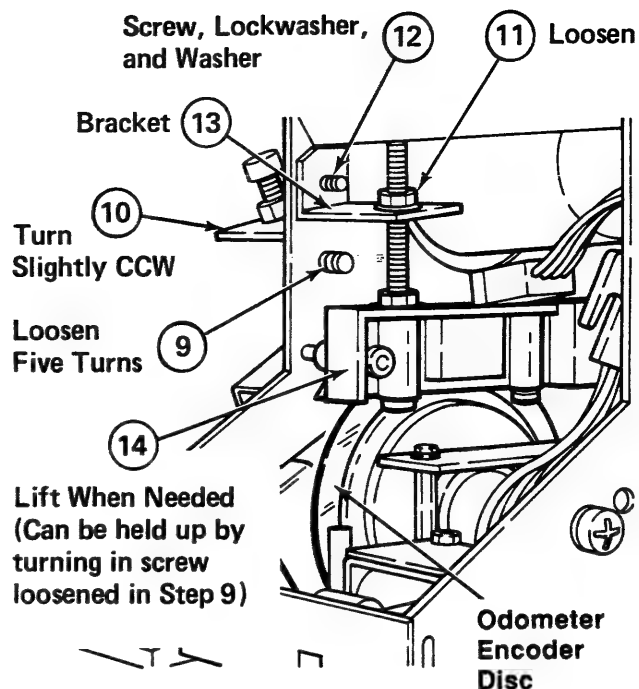
Note

If Page Search has been installed, remove the Blip Sensor Assembly.

6. Remove the Left Front metal Plate Assembly (see Puck Disassembly Procedure 4-5, page 4-8 up to and including Step 11).
7. Remove the Peripheral PWA (Disassembly 4-3.2, page 4-4).
8. Remove the Processor PWA (Disassembly 4-3.2, page 4-5).

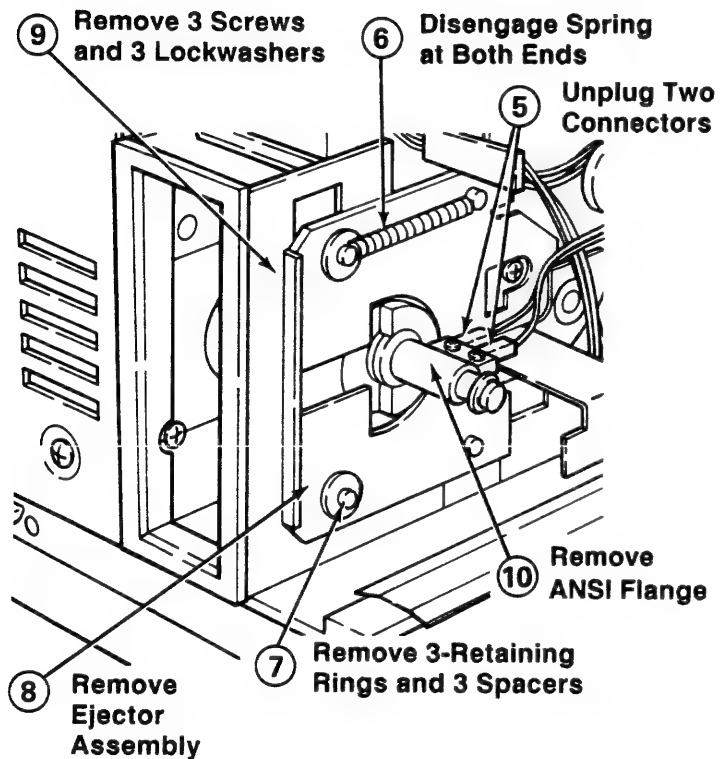
Note

Do Odometer Sensor (S7) Adjustment 3-10.6 after this procedure. If a Page Search Blip Sensor Assembly has been installed, do Blip Sensor Assembly Position Adjustment 3-2 and Film Sensor (S6) Adjustment 3-3 found in the 656 Section.



4-7. ANSI FLANGE

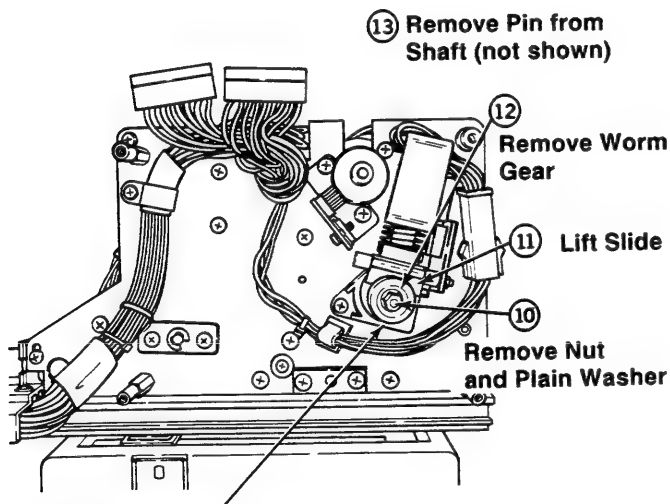
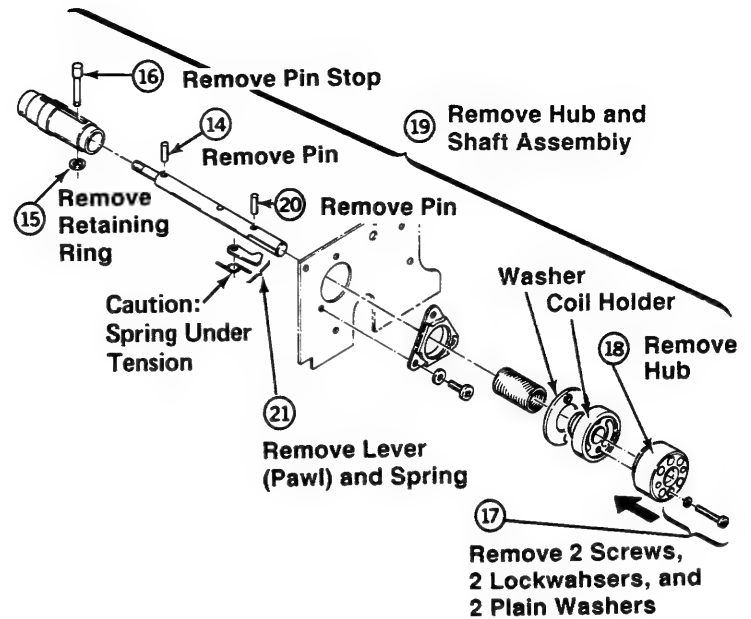
1. Unload film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).
4. Remove the Front Left Cover (Disassembly 4-2.1, page 4-1).

**Reassembly Tip:**

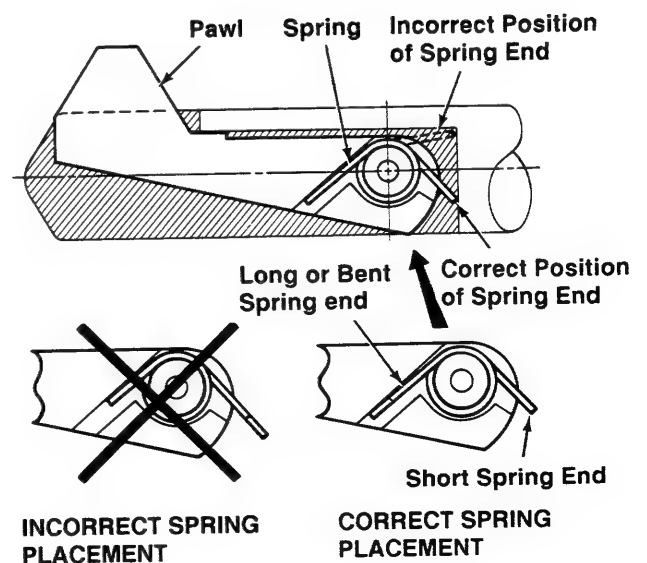
Be sure the right tab of the Ejector Assembly is positioned between the Spring Clip and Film Start Switch Actuator.

4-8. LEVER (PAWL)

1. Unload film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).
4. Remove the Front Left Cover (Disassembly 4-2.1, page 4-1).
5. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
6. Remove the Top Left Cover (Disassembly 4-2.4, page 4-2).
7. Remove the Peripheral and Processing PWA's (4-3.2, 4-3.3).
8. Remove the Film Reverse Motor (steps 9, 10 in procedure 4-4, Film Reverse Motor and Drive Belts).
9. Remove the ANSI Flange (Disassembly 4-7., page 4-10).

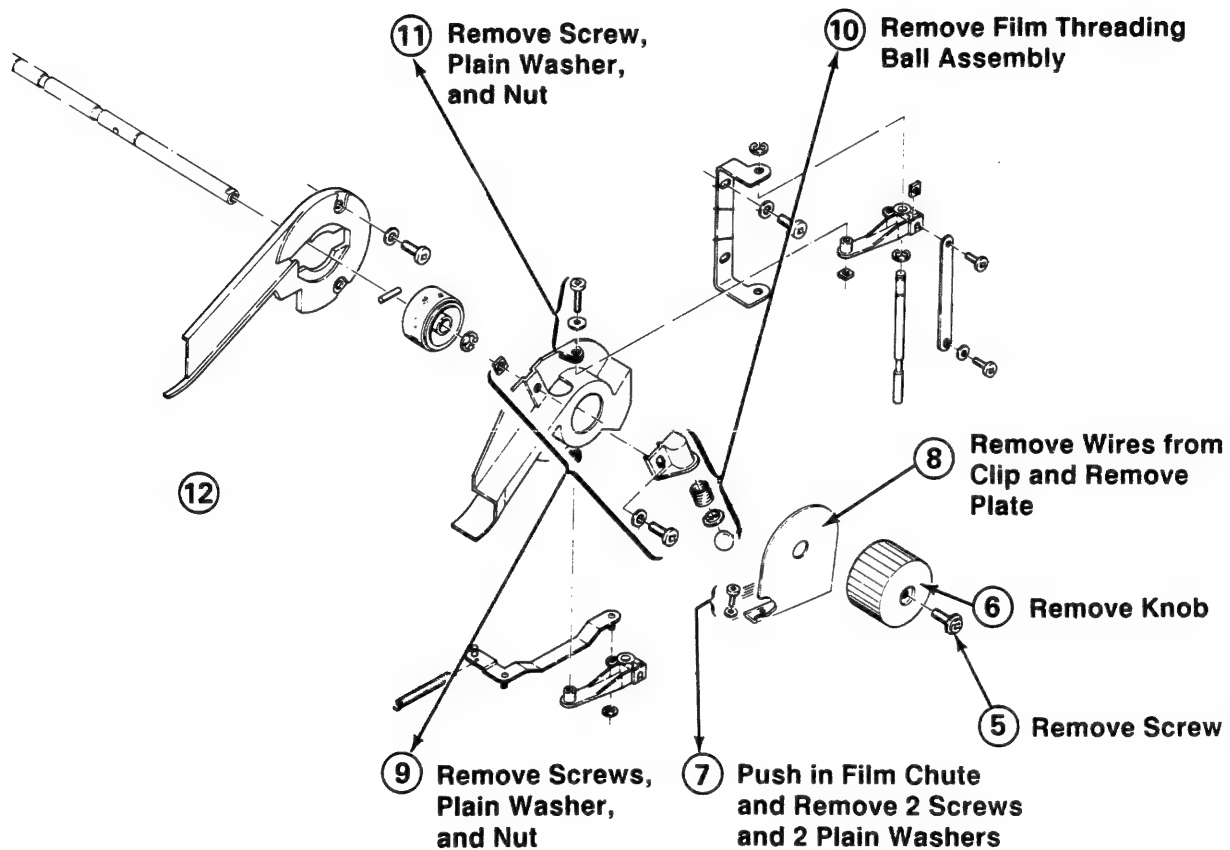


Caution:
When the head of the Stop Pin is up, the flat on the Worm Gear must also face up.



4-9. FILM CHUTE

1. Unload Film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).
4. Remove the Front Right Cover (Disassembly 4-2.2, page 4-1).

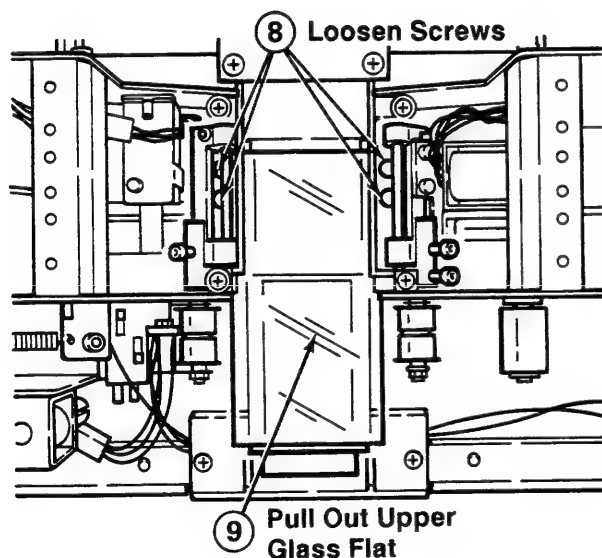


4-10. UPPER GLASS FLAT

Note

The Upper Glass Flat is not recommended to be removed for cleaning. If the Upper Glass Flat is removed and the 12 mm Spacer Tape is damaged, the tape must be replaced.

1. Unload film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).
4. Remove the Lower Glass Flat (210 CAT Operating Instructions).
5. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
6. Remove the Top Left Cover (Disassembly 4-2.4, page 4-2).
7. Remove the Top Right Cover (Disassembly 4-2.5, page 4-3).

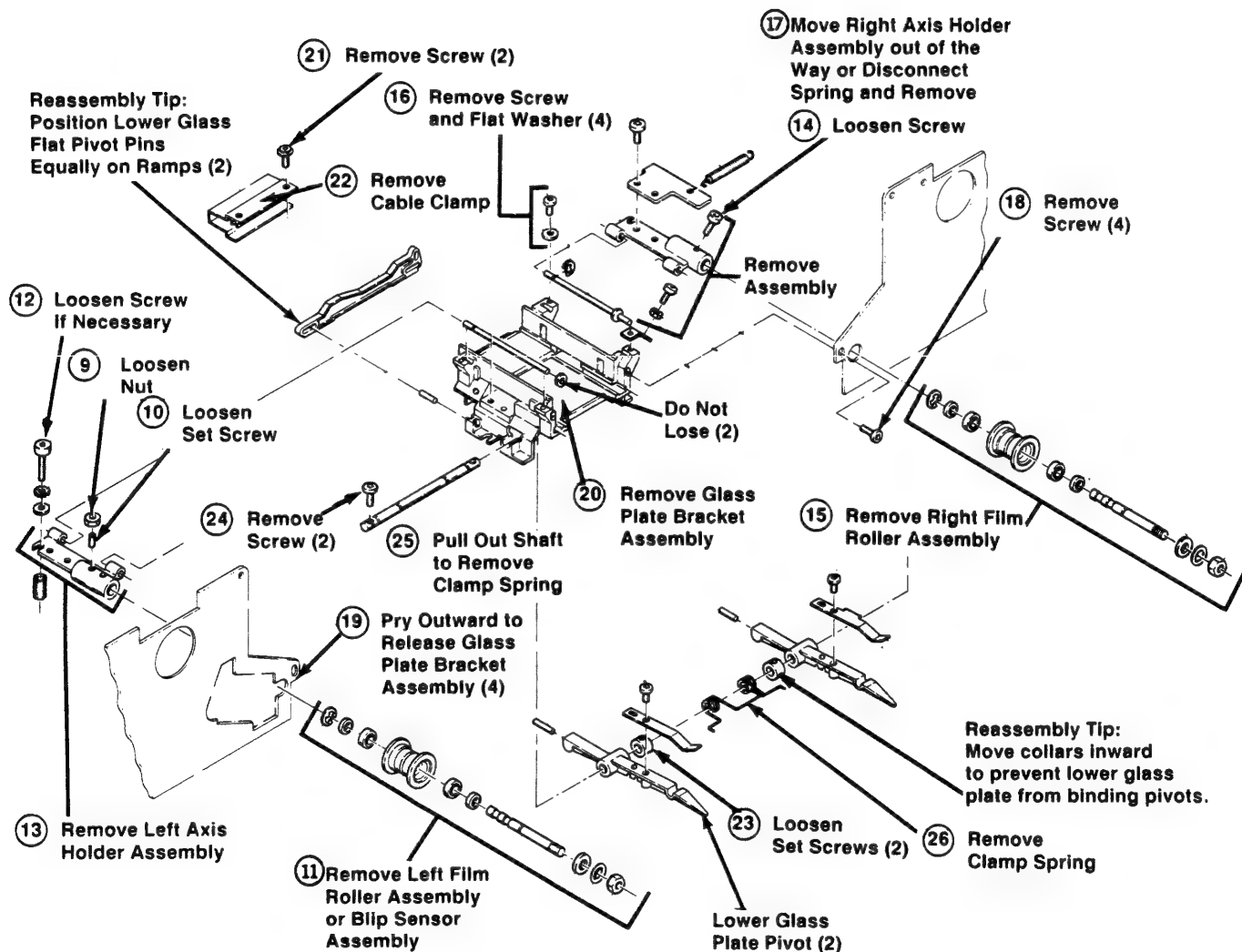


Reassembly Tip:

Do not overtighten the Screws but tighten firmly enough to prevent the Upper Glass Flat from falling out.

4.11. FILM CLAMP SPRING

1. Unload film and switch OFF the Reader-Printer.
2. Disconnect the M-654.
3. Remove the M-654 (210 CAT Operating Instructions).
4. Remove the Lower Glass Flat (210 CAT Operating Instructions).
5. Remove the Rear Cover (Disassembly 4-2.3, page 4-2).
6. Remove the Top Left Cover (Disassembly 4-2.4, page 4-2).
7. Remove the Top Right Cover (Disassembly 4-2.5, page 4-3).
8. Remove the Upper Glass Flat (Disassembly 4-11, page 4-15).



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5-1. CLEANING**5-1.1. Machine**

Gently wipe the machine with a clean cloth dampened with alcohol.

5-1.2. Glass Flats

1. Remove film from the machine (See 210 CAT Operating Instructions).
2. Pull the Lower Glass Flat straight towards you.
3. Clean both sides of the Lower Glass Flat and the Upper Glass Flat with any commercial lens cleaner and a soft, clean cloth or tissue.
4. Position the Lower Glass Flat and push straight back until both pins engage.

5-1.3. Film Path Components

1. Clean the Puck and Take-Up Roller with alcohol every 2,000 cycles.
2. Clean the Odometer Roller with alcohol every service call.

5-2. FILM STORAGE AND HANDLING

Refer to Basic Micrographics.

5-3. PEM Checklist

Section	Item to Check	Every Call	Each 10K	Each 20K	Replace Every	Remarks
External	Overall Machine Glass Flats Tape Strips	CH	CL		10K	
Internal	Brake Disc Cartridge Drive Hub Encoder Disc Roller Film Chute Drive Belts Switches Sensors Solenoids Film Traverse Take-Up Roller Puck	CH CH CL CH CH CH CH CH CH CL CL	CL			with alcohol with alcohol with alcohol
NOTES:	CH Check in Operation CL Clean, see Cleaning Chart					

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6-1. OVERVIEW

The M-654 (210 CAT) is a motor driven cartridge film transport for 16mm microfilm. It is used as an option on the M-7530 or M-7540 Reader-Printer for viewing negative or positive microfilm images and printing positive 8-1/2 " by 11" or A4 size copies.

The M-654 transports film from a film spool spindle via guide rollers between two glass flats onto a take-up reel. As an operator loads a cartridge of film, the film is automatically threaded onto the take-up reel.

The operator can slowly or quickly advance or reverse film and hold an individual frame for viewing or printing. An operator controlled film speed control determines which of two motors will run and at what speed. To avoid damaging the film during fast forward or fast reverse speeds, the lower glass flat and right guide roller are automatically lowered when a certain film speed is reached. The motor speed is electronically controlled by an optical switch and encoder disc.

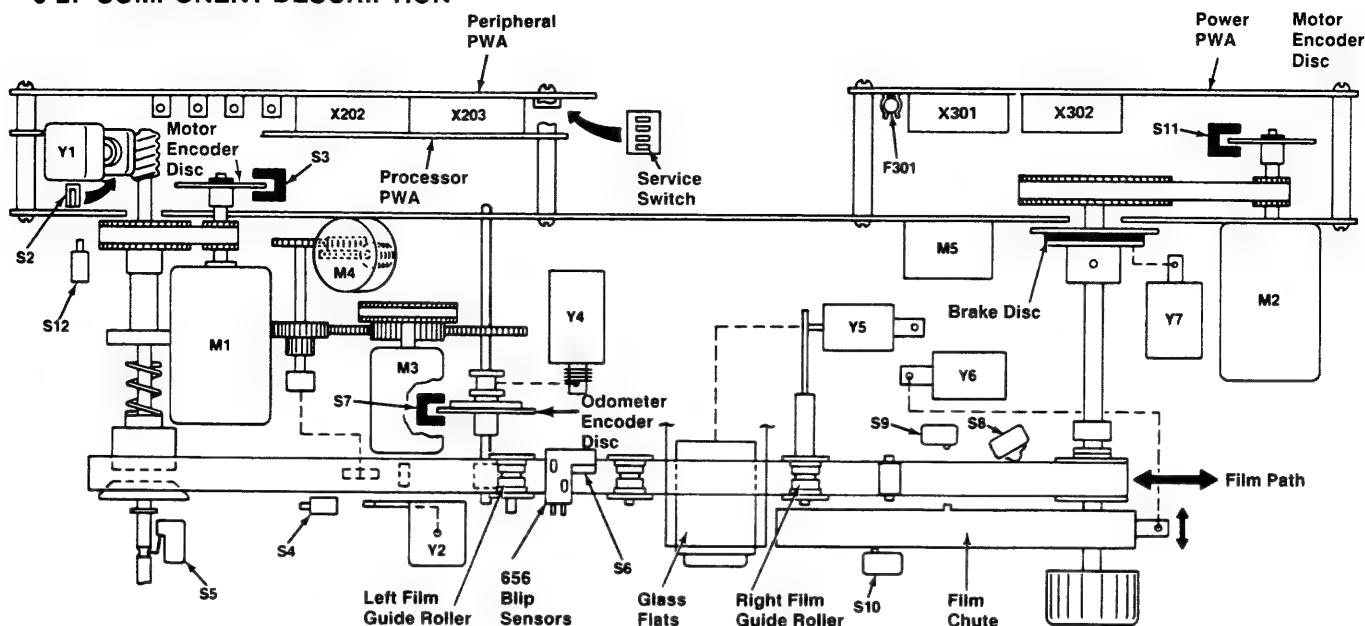
A film odometer can assist the operator in locating specific film frames. The operator can manually search images also. The film is held in constant tension by an electrical torque balance of both motors.

A manual film traverse control moves the image of the film frame up or down for better location on the Viewing Screen.

A simple lamp and lens system transmits the enlarged microfilm image onto a viewing screen.

The operator can easily remove the M-654 and exchange it for another form of microfilm handler or locate images using the optional M-656 Page Search.

6-2. COMPONENT DESCRIPTION

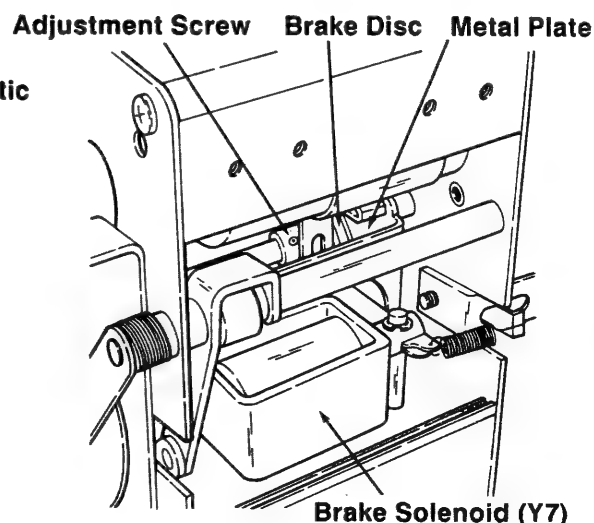
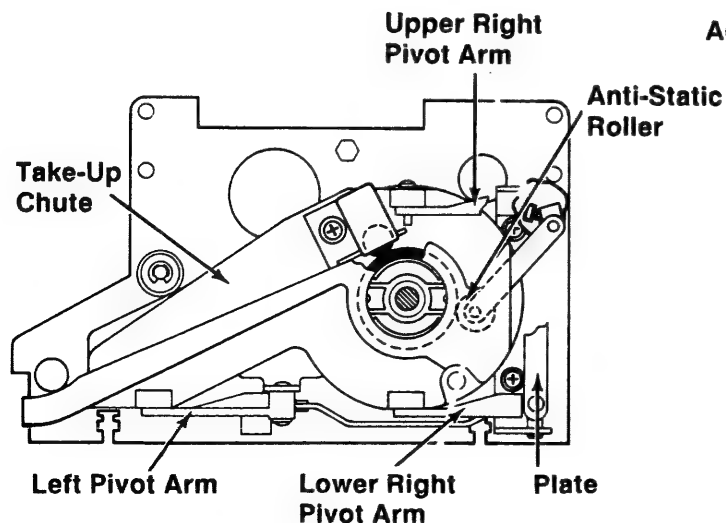


ANSI Hub Pressure Spring--Prevents the Hub from pushing in the walls of black 3M Film Cartridges to keep them from welding.

Anti-Static Roller--Pulled away from the Take-Up Reel by Film Chute Solenoid (Y6) during auto-thread. Should apply a continuous ground during film movement. If the roller "bounces", a voltage spike may be generated on the +5 vdc line causing the M-654 software to be "lost". The resulting Error Code 1002 can be cleared by pressing the Reset Switch (S1) to restore the software. See Adjustment 3-13. Anti-Static Roller, page 3-30. Diagnostic Code 36.

Blower Motor (M5)--Motor and 6-bladed fan cools the Power PWA by drawing heat away.

Brake Disc--Provides enough drag when engaged to prevent film movement when the Film Speed Control is at its "0" position. The Brake Disc applies braking action by spring pressure against the Friction Disc Plate when the Brake Solenoid (Y7) is deactuated. An adjustment is made to ensure that the Brake Disc releases completely when the Brake Solenoid (Y7) energizes, yet engages properly when deenergized. If the spring pressure is too high, the Film Speed Control will be difficult to turn. See Adjustment 3-3. Adjustment 3-3 Brake Disc, page 3-3. Diagnostic Code 37.

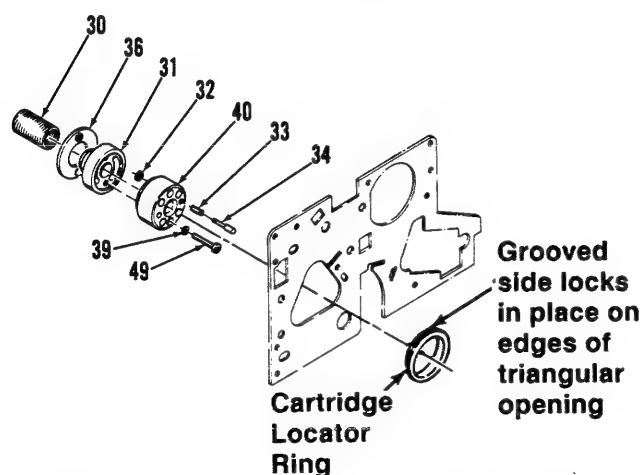


Brake Disc Solenoid (Y7)--Deactuates to allow the rotating Brake Disc to be pulled against the stationary Friction Disc Plate by a spring when the Film Speed Control is turned to "0". Actuates during auto-thread and film scan to allow unrestricted film movement. Solenoid power can be measured +27 vdc at X302-3 on the Power PWA and +12 vdc at X202-20 on the Peripheral PWA. Diagnostic Code 37.

Cartridge Eject Solenoid (Y2)--Releases the Slide Plate Latch to allow the Cartridge Slide Plate to eject the cartridge by spring force. Solenoid power can be measured +27 vdc at X302-3 on the Power PWA and +12 vdc at X202-2 on the Peripheral PWA. Diagnostic Code 32.

Cartridge Jam Switch (S12)--Provides an alternate circuit to power the Film Reverse Motor (M1) to withdraw the Spindle from the film cartridge if it does not eject at the end of rewind. This circuit is active only with Category 3 Error Codes for machines prior to 5401070. See Adjustment 3-10.11 Cartridge Manual Eject Switch (S12), page 3-26.

Cartridge Locator Ring--Corrects the majority of cartridge jamming problems by maintaining the position of the film reel in the ANSI Cartridge during the eject cycle.



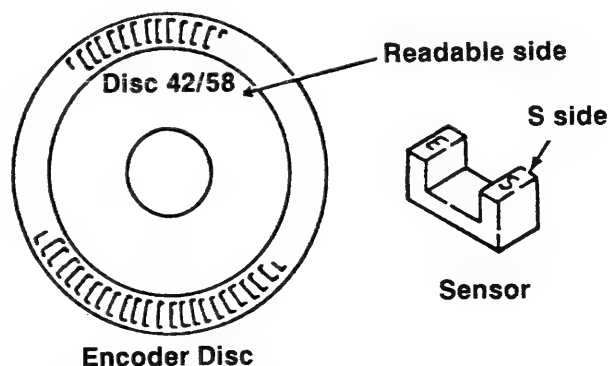
Cleaning Cartridge--Used to clean the Puck if film is not pulled out of the cartridge during a normal Auto-Thread routine. When the Cleaning Cartridge is inserted in the

M-654, the machine will cycle twice and then eject the cartridge. Error Category Code 2 will appear in the LED display but should be ignored. As the cleaning roller becomes soiled it can be turned slightly to expose a new area. The Cleaning Cartridge should be inserted dry.

Display PWA--Small Printed Wiring Assembly containing the 4-digit LED Film Odometer/Error Status/Diagnostic Function display.

Drive Belts--Splined to ensure maximum torque, they should not be adjusted so tight they put undue loads on the motor shafts, or so loose that they slip. See Adjustment 3-9 Drive Belts, page 3-10. The Drive Belt for the Film Reverse Motor (M1) drives the Spindle Shaft which drives ANSI Film Cartridges and the Cartridge Drive Hub which drives 3M Film Cartridges. The Drive Belt for the Film Advance Motor (M2) drives the Film Take-Up Reel. The Drive Belt for the Film Thread Motor (M3) drives the Odometer Encoder Disc through a gear train during auto-thread.

Encoder Disc--Consists of a photoelectric encoder in which the reading head consists of a light source on one side of the disc and a corresponding light sensor facing it on the other side of the disc. The coded pattern is evenly spaced, partly translucent, partly opaque. As the disc turns, the pattern acts as an on/off switch to produce a digital signal. The optical sensor will switch on ("1") or off ("0"). The faster the disc turns, the faster the pulse generated. When used as an odometer, the signal advances or decreases a counter by "1" for each pulse. When used to measure motor speed, the pulses generated by the Odometer Encoder Disc are compared with the pulse of the Motor Encoder Disc. See Motor Encoder Disc and Odometer Encoder Disc.



Film Advance Motor (M2)--Drives the Take-Up Reel to advance film during film loading and forward scan. It is also powered in opposition to the Film Reverse Motor (M1) to maintain film tension after a reverse film scan. The Film Advance Motor (M2) is powered by voltage pulses. Placing probes on X302-9 and X301-13 on the Power PWA, and pressing the Reset Switch (S1) several times should show an intermittent pulse of up to + 0.9 vdc. Any indication of voltage is evidence that pulses to the motor are being generated. Motor speed signals are routed from the Peripheral PWA to the Power PWA to control the pulses that drive the Film Advance Motor (M2). The amplitude of the motor speed signal is proportional to the speed selected. The motor speed signal at 50% of rated current is about + 1.3 vdc. Diagnostic code 52.

Film Advance Motor Speed Sensor (S11)--Alternates ON ("1") as it is struck by light allowed to pass through and off ("2") as light is blocked by lines on the rotating Motor Encoder Disc for the Film Advance Motor (M2). Sensor input frequency is compared to Odometer Encoder Disc (S7) frequency during rewind to determine end of film. Adjustment consists of making sure the lines on the encoder disc pass in front of the sensor but that the disc does not touch the sides of the sensor. The Motor Encoder Disc is positioned as close to the sensor as possible to minimize light dispersion. The "readable" side of the disc should face the "S" side of the sensor. See Adjustment 3-10.10 Advance Motor Speed Sensor (S11), page 3-25. Sensor power can be measured + 24 vdc at X302-2 and + 5 vdc at X301-8 on the Power PWA.

Film Chute--Closes during auto-thread to guide the film onto the Take-Up Reel and opens when completed. The closed Film Chute should be wide enough to not impede the auto-threading of the leader of a 3M Film Cartridge during the allotted time by the Microprocessor, but narrow enough to ensure accurate placement on the Take-Up Reel. Too wide a gap will also allow the Leader Sense Switch (S8) to intermittently actuate and deactuate to cause mispositioning of the leader splice. If the gap for the Film Chute is too narrow when it is in the OUT position,

Film Chute (Con't.)--the abrasive action of the film during movement will cause dust particles from the film and Film Chute to cause the film cartridge to bind during insertion. See Adjustment 3-6 Film Chute Parallelism, page 3-6; Adjustment Film Chute OUT Gap, page 3-7; and Adjustment 3-8 Film Chute IN Gap, page 3-8.

Film Chute-In Switch (S9)--Signals the Microprocessor that the Film Chute is in for auto-threading. A tab on the Film Chute is the actuator. If misadjusted, could cause Error Code 1006 at Power-On. See Adjustment 3-8 Film Chute IN Gap, page 3-8. Diagnostic Code 09.

Film Chute-Out Switch (S10)--Signals the Microprocessor that the Film Chute is out for normal film scanning. The pivot for the Film Chute is the actuator. If misadjusted, could cause Error Code 1006 at Power-On. See Adjustment Film Chute OUT Gap, page 3-7. Diagnostic Code 10.

Film Chute Pivot Bracket--Positions the Film Chute for proper operation. See Adjustment 3-17. Film Chute Pivot Bracket, page 3-34.

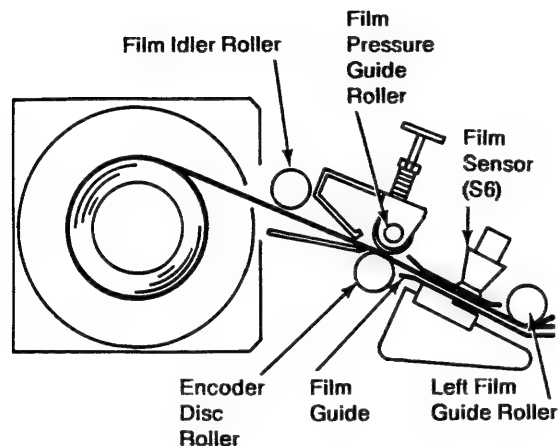
Film Chute Solenoid (Y6)--Actuated by the Microprocessor to pull the Film Chute in and the Anti-Static roller away from the Film Take-Up Reel for auto-threading. See Adjustment 3-8. Film Chute In Gap, page 3-8. Solenoid power can be measured + 27 vdc at X302-3 on the Power PWA and + 12 vdc at X202-19 on the Peripheral PWA. Diagnostic Code 36. Actuates freely on 3605.

Film Clamp Solenoid (Y5)--Lowers the Lower Glass Flat when actuated to prevent film from scratching during high speed scans or jamming during auto-thread. A Spring raises the Lower Glass Flat when the solenoid is deactuated. Solenoid power can be measured + 27 vdc at X302-3 on the Power PWA and + 12 vdc at X202-18 on the Peripheral PWA. Diagnostic Code 35.

Film Guide--Guides film as it passes from the Odometer Encoder Disc Roller and Film Pressure Guide Roller to the Left Film Guide Roller during auto-threading. Keeps any curl at the end of the film flattened. Also directs the end of the film between the Glass

Film Guide (Con't.)--Flats during auto-threading. Maintains the correct distance of the film to the Film Sensor (S6).

Film Guide Rollers--Guides film during auto-threading and film scanning and holds the film off the surface of the Upper Glass Flat to minimize the possibility of scratching during scanning operations. See Adjustment 3-2, Film Guide Rollers, page 3-1.

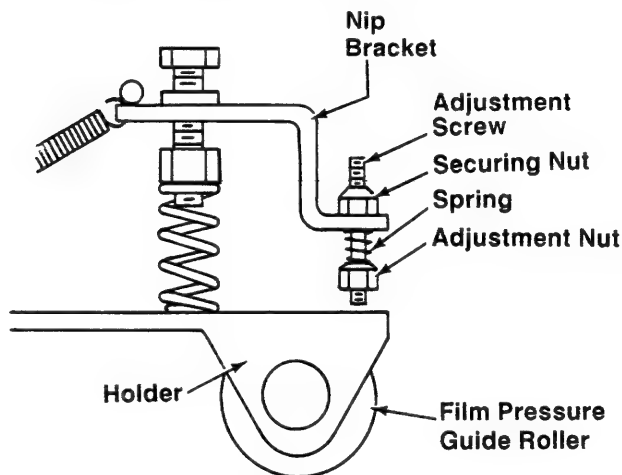


Film Idler Roller--Guides film during film scan and Rewind/Eject routines.

Film Odometer--Serves as a reference for locating frames of film. Automatically resets itself to 0000 after auto-threading. Does not measure actual film length. Four-digit LED display on a small PWA connected to the Peripheral PWA. Alternately used as a Status/Error Signal Display.

Film Pressure Guide Roller--Applies additional pressure on the film leader during auto-thread to prevent the Film Cartridge from ejecting because of an incomplete film wrap around the Take-Up Reel. Helps to properly track film so it does not drive erratically during scanning. Moving film passes between the Encoder Disc Roller and the spring-loaded, pivoted, Film Pressure Guide Roller to drive the Odometer Encoder Disc. Accurate odometer counting depends on smooth, parallel tracking of the film and rollers. See Adjustment 3-14, Film Pressure Guide Roller, page 31, and Adjustment 3-15. Auxiliary Nip Pressure, page 3-32.

Film Reverse Motor (M1)--Drives the Spindle Shaft to return film into the cartridge during a rewind or reverse film scan. It is also powered in opposition to the Film Advance Motor (M2) to maintain film tension during a forward film scan. The Film Reverse Motor (M1) is powered by voltage pulses. Placing probes on X301-7 and X301-13 and pressing the Reset Switch (S1) several times should show an intermittent pulse of up to + 0.9 vdc. Any indication of voltage is evidence that the pulses to the motor is being generated. Motor speed signals are routed from the Peripheral PWA to the Power PWA to control the pulses that drive the Film Reverse Motor (M1). The amplitude of the motor speed signal is proportional to the speed selected. The motor speed signal at 50% of rated current is about + 1.3 vdc. Diagnostic Codes 40, 41, 50, and 51.



Film Sensor (S6)--Reflective photosensor that indicates the presence of film in the threading path of the Film Guide. The dull side of exposed silver halide film is the worst case for sensing. See Adjustment 3-10.5 Film Sensor (S6). Sensor power can be measured + 24 vdc at X302-2 on the Power PWA.

Film Speed Control--A multi-function potentiometer that varies the signal voltage input to the Peripheral PWA. Turned CW or CCW from a null "0" position.

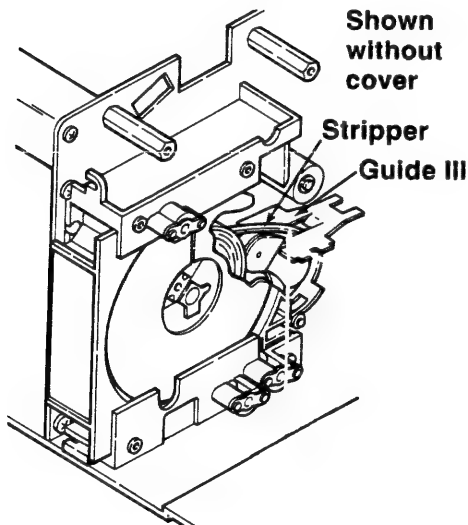
When Slide 1 of the Service Switch is in its on (normal) position, the voltage will advance or reverse film at varying speeds. When the Film Speed Control is turned slightly from the "0" position, the glass

flats remain closed and film will move slowly. When fully turned, the glass flats will open and film will move quickly.

When Slide 1 of the Service Switch is in the off (diagnostic) position, The Film Speed Control is used to select specific components and vary their inputs for testing.

Film Start Switch (S4)--Actuates when a film cartridge is inserted, removing the Ground it applies to the Peripheral PWA which starts the auto-thread program. See Adjustment 3-10.3 Film Start Switch (S4), page 3-15. Diagnostic Code 04.

Film Stripper--"Strips" film from a cartridge at start of auto-thread. As the film spool turns, the end of the film hits the Stripper forcing the end of the film to travel down its length until it hits the Guide III and into the Film Guide. See Adjustment 3-16 Stripper Position, page 3-33.



Film Take-Up Reel--Driven by the Film Advance Motor (M2), takes-up film during auto-thread and normal film scanning. Accepts 16 mm film.

Film Thread Motor (M3)--Drives the Puck through a belt and series of gears during auto-thread. The Puck rotates the film reel clockwise at the beginning of an auto-thread sequence. It also drives the Odometer Encoder Disc Roller at the same time to continue to drive film to the Film Take-Up

Film Thread Motor (M3) (Con't.)--Reel. The Film Thread Motor (M3) is powered by voltage pulses. Placing probes on X302-8 and X301-13 on the Power PWA, and pressing the Reset Switch (S1) several times, should show an intermittent pulse of up to + 0.9 vdc. Any indication of voltage is evidence that the pulses to the motor is being generated. Motor speed signals are routed from the Peripheral PWA to the Power PWA to control the pulses that drive the Film Thread Motor (M3). The amplitude of the motor speed signal is proportional to the speed selected. The motor speed signal at 50% of rated current is about + 1.3 vdc. Diagnostic Code 43.

Film Threading Ball--Helps to wrap film during auto-thread. Should just touch the Film Take-Up Reel while allowing the Film Chute to pull in when the Film Chute Solenoid (Y6) is energized. If the Film Chute pulls in sluggishly, the ball is too tight. See Adjustment 3-12 Film Threading Ball, page 3-28. Diagnostic Code 36.

Film Traverse Control--Mechanical device used to move the screen image on the Reader-Printer vertically by moving the Cabinet and Frame Assembly forward or back with relation to the Base Assembly. This movement is accomplished through a gear and eccentric arrangement in the Base Assembly. Adjustment consists of positioning the Gear Bracket to provide proper tension on the Drive Belt and tightening the screws. See Adjustment 3-11, Film Traverse, page 3-27.

Glass Flats--Allows to pass light for the optical system of the Reader-Printer. Presses the film relatively flat during viewing or printing and free of dust when moving. The Lower Glass Flat "clamps" the film by spring pressure when the Film Clamp Solenoid (Y5) is deactuated. The Glass Flats should be parallel with each other but not touching. Actuation of the Film Clamp Solenoid (Y5) lowers the Lower Glass Flat and Right Guide Roller against the film so the film does not drag on the Upper Glass Flat. Diagnostic Code 35.

Guide I--Vertical guide for the rear edge of film near where the film comes out of the film cartridge.

Guide II--Vertical guide for the front edge of film near where the film comes out of the film cartridge.

Guide III--Horizontal guide for the leading edge of film during auto-thread.

Leader Sense Switch (S8)--Signals the Microprocessor that the film being loaded is 3M film having a leader. the auto-thread sequence will go through a longer routine to place the splice just to the right of the glass flats. If the switch is defective, the splice would be to the left of the glass flats. If misadjusted, film will loop on the Take-Up Roller or within the film cartridge. As the film tightens and lashes, the Spindle Shaft drives the Pawl (Lever) against the drive slot of ANSI Film Cartridges which may break the drive key of a plastic Pawl. See Adjustment 3-10.7. Leader Sense Switch (S8), page 3-22. Diagnostic Code 08.

Manual Eject--Mechanical device used to manually eject jammed film cartridges.

Manual Scan Control--Manually moves film forward or reverse. The Brake Disc should not be adjusted so tight as to hinder film movement. See Adjustment 3-3. Brake Disc, page 3-3.

Microswitches--Basically adjusted so contact is not made with the switch body when they are actuated. A status change will occur when deactuated. See Adjustment 3-10.1 Spindle Position Switch, page 3-13; 3-10.3 Film Start Switch (S4), page 3-15; 3-10.5 3M Cartridge Switch, page 3-16; 3-10.7 Leader Sense Switch, page 3-22; 3-10.8 Film Chute IN Switch (S9, page 3-29; 3-10.9 Film Chute OUT Switch (S10); 3-10.12 Cartridge Manual Eject Switch, page 3-26. Overtightening the Mounting Screws will cause switch failure. The plastic body of the switch will "creep" causing the switch to bind. The Diagnostic Mode of the M-654 can check all switch functions and their status (see Diagnostics, page).

Microprocessor--The D240 Latch, U260 I/O Ports and U240 I/O Ports, U270 Digital to Analog Converter, and U280 Multiplexer, are located on the Peripheral PWA. The Clock, Z80 D140 CPU, D110 EPROM, D120 EPROM, and D130 RAM are located on the Processor PWA. The Pulse Width Modulators for the motors are located on the Power PWA.

Motor Encoder Discs--Used in conjunction with the Reverse Motor Speed Sensor (S3) and Advance Motor Speed Sensor (S11) to provide a measure of speed for the Film Reverse Motor (M1) and Film Advance Motor (M2) respectively. The pulses generated are compared to the Odometer Encoder Disc to detect the approach of the end of the film and are used to limit the maximum motor speed. The discs must be installed so their "readable" side faces the "S" side of the Encoder Sensor. The "readable" side is the side on which the writing is upright and readable. Diagnostic Codes 03 and 11.

Odometer Encoder Disc--A flat clear disc having lines along the edges to block the path of light to a pair of optical sensors. As the disc rotates, alternate blocking of light causes the sensors to switch on ("1") and off ("0"). When used to control motor speed, the pulse width of the Odometer Encoder Disc and Motor Encoder Disc is compared. See Adjustment 3-10.6 Odometer Sensor (S7), page 3-18. Diagnostic codes 17, 18, 19, and 47.

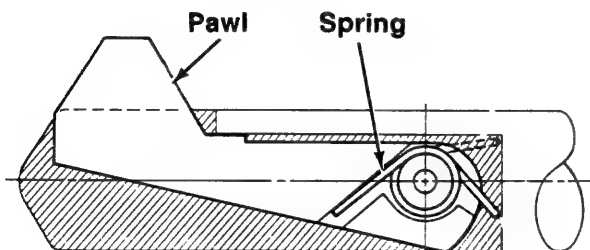
Odometer Encoder Disc Roller--Moving film passes between the Encoder Disc Roller and the spring-loaded, pivoting Film Pressure Guide Roller to drive the Odometer Encoder Disc. Accurate odometer counting depends on smooth, parallel tracking of the film and rollers. See Adjustment 3.5 Encoder Disc Roller, page 3-5.

Odometer Clutch--Used to engage the Odometer Encoder disc to the Film Thread Motor (M3) during the auto-thread sequence. Diagnostic Code 47.

Odometer Clutch Solenoid (Y4)--Engages the Odometer Clutch to drive the Odometer Encoder Disc during auto-thread. Solenoid power can be measured +27 vdc at X302-3 on the Power PWA and +12 vdc at X202-17 on the Peripheral PWA.

Odometer Sensors (S7)--Provides pulses generated by the Odometer Encoder Disc to control the speed of Film Reverse Motor (M1) and Film Advance Motor (M2). Also provides directional and count information that enables a given frame of film to be accurately relocated. The Odometer Encoder Disc must be parallel with the slot for the Odometer Sensors. See Adjustment 3-10.6 Odometer Sensor (S7), page 3-18. Sensor power can be measured +24 vdc at X302-2 on the Power PWA. See Adjustment 3-10.6 Odometer Sensor (S7), page 3-18. Diagnostic codes 17, 18, and 19.

Pawl--Metal lever (once plastic) on the Spindle Shaft engages the hub of ANSI Film Cartridges to drive film. The Pawl is also a key that allows the 3M Cartridge Drive Hub to drive 3M Film Cartridges.



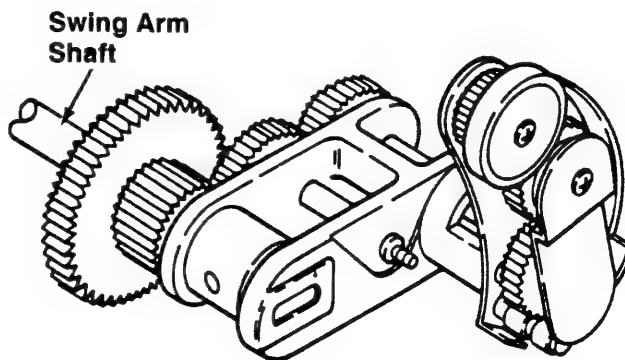
Peripheral PWA--Interface between the logic routines stored in the Processor PWA and the rest of the machine. It monitors the status of the components and functions of the M-654 and controls their operation through a Microprocessor. The Peripheral PWA provides a Return Circuit for all solenoids.

Power PWA--Rectifies 27 VAC to provide +5 vdc to the Peripheral PWA, Processor PWA, and digital display, and +24 vdc to the Peripheral PWA, Advance Motor Speed Sensor (S11), Reverse Motor Speed Sensor (S3), all other sensors, and all motors except the Blower Motor (M5). Provides unregulated +27 vdc to all the solenoids and the Blower Motor (M5). A red LED on the Power PWA lights when +27 vdc is uninterrupted. This does not mean +5 vdc or +24 vdc is available. The Power PWA also controls the speed of the Film Reverse Motor (M1) and Film Advance Motor (M2). A 5 Amp Fuse on the Power PWA protects it from load surges.

Power to the M-654 Power PWA comes from the Reader-Printer. The 27 VAC comes through the wiring harness from J100 of the Reader-Printer to X301 of the M-654. J100 is located behind the Right Side Door of older M-7530s. Later version M-7530s and all M-7540s have J100 accessed through the Lower Left Cover. If the LED display is blank, the Reader-Printer should be checked. There is an in-line, 5 amp Fuse in the Reader-Printer before it reaches J100. This fuse can be accessed on older M-7530s through the opening in the frame near the Print Counter(s) and by removing the Lower Left Cover for later version M-7530s and all M-7540s.

Processor PWA--Interprets, controls and times the various functions of the M-654 through a Microprocessor.

Puck Assembly--Drives the film reel inside the cartridge clockwise against the Counterclockwise drive of the the Film Reverse Motor (M1) during auto-threading. When the Swing Motor (M4) advances the Puck Assembly toward the film cartridge, a Film Stripper diverts the end of the film over its length until it guides it between Guide I and Guide II and over Guide III into the Film Guide. The Puck is driven by the Film Thread Motor (M3) through a gear train. The Swing Motor (M4) retracts the Puck Assembly after the film reaches the Film Sensor (S6). From there the Odometer Roller drives the film to complete auto-thread. The rubber Puck should be cleaned with the Cartridge Cleaner or a soft clean cloth dampened with alcohol. The Puck should be replaced before the metal side plates wear against the film. Diagnostic Codes 38, 39, and 43.



Reset Switch (S1)--Multifunction switch. Part of the Odometer PWA, it applies a ground signal to the Peripheral PWA when pressed.

When Slide 1 of the Service Switch (S15) is pushed to its on (normal) position, returns Film Odometer to 0000 when pressed.

When Slide 1 of the Service Switch (S15) is pushed to its off (diagnostic) position, used to select a component for diagnostic testing, actuate the component selected, or instruct the Microprocessor to select another component.

Reverse Motor Speed Sensor (S3)--Alternates ON ("1") as it is struck by flashes of light allowed to pass through the lines on the rotating Motor Encoder Disc and off ("2") as light is blocked. Sensor input frequency is compared to the Odometer Encoder Disc frequency during film advance to determine end of film. Adjustment consists of making sure the lines on the encoder disc pass in front of the sensor but does not touch the sides of the sensor. The Motor Encoder Disc is positioned as close to the sensor as possible to minimize light dispersion. See Adjustment 3-10.2 Reverse Motor Speed Sensor (S3), page 3-14. Sensor power can be measured +24 vdc at X302-2 and +5 vdc at X301-8 on the Power PWA. Diagnostic Code 03.

Solenoids--Actuate when power is switched on. Return Circuit is furnished by the Peripheral PWA. Failure to function could be caused by the Power PWA, Peripheral PWA, or the solenoid itself.

Spindle Position Switch (S2)--Signals the Microprocessor that the Slide Gear is up and the Spindle Release Solenoid (Y1) has actuated to allow the Spindle Shaft to engage with an inserted film cartridge. See Adjustment 3-10.2 Spindle Position Switch, page 3-13. Diagnostic Code 02.

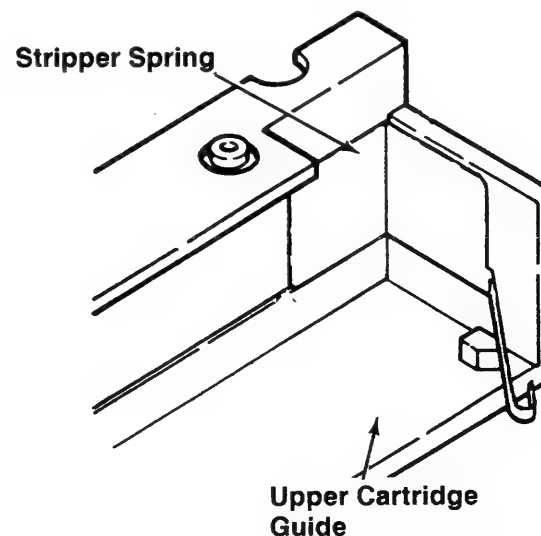
Spindle Release Solenoid (Y1)--Energizes to allow the Spindle Shaft to engage with an inserted cartridge and remains energized until the eject routine is activated.

Solenoid power can be measured +27 vdc at X302-3 on the Power PWA and +12 vdc at X202-16 on the Peripheral PWA. Diagnostic Code 01.

Status/Error Signal Display--Displays status, error signals, or output values for troubleshooting. A single digit appearing on the left of the display is the Malfunction Category Number. By pressing and holding the Reset Switch (S1), the entire Error Code will display.

When Slide 1 of the Service Switch (S15) is pushed to its off position, components of the M-654 can be diagnostically tested. A flashing 2-digit number will display indicating a diagnostic code for a component. Turning the Film Speed Control will change the diagnostic code to the desired component to be tested. A steady 2-digit display on the right indicates the component to be tested and its status or output value. Turning the Film Speed Control again will display a percentage (00 to 99) of rated current to motors M1, M2, and M3; or voltage pulse width (00 to 08) to M4 or a solenoid.

Stripper Spring--Option for accounts which use 3M Film Cartridges only. The Stripper Spring is installed on the Upper Cartridge Guide to push the film leader back so it doesn't stub on the cartridge during auto-threading. The Stripper Spring must not be used with ANSI Film Cartridge.



Swing Motor (M4)--A reversible motor that moves the Puck Assembly toward the film cartridge for auto-threading and away from it when auto-threading has been completed. Accomplished through a worm gear drive and gear train. The Swing Motor (M4) is powered by +24 vdc from the Power PWA. It runs when a Return is provided by the Power PWA. A relay on the Power PWA determines wh

Thermofuses--Protects the film drive motors M1 and M2 and all solenoids. When a Thermofuse opens, all components in the +27 vdc circuit are disabled. If a Thermofuse for the Film Reverse Motor (M1) or Film Advance Motor (M2) opens, the Thermofuse can be replaced. If a Thermofuse for one of the Solenoids opens, the solenoid must also be replaced.

3M Cartridge Drive Hub--Drives the Film Spool of 3M Film Cartridges. The Cartridge Drive Hub should extend into an inserted 3M Film Cartridge far enough that the Drive Pins engage fully with the hub of the cartridge, but not so far that they cannot be completely withdrawn. If the Drive Pins can not be fully withdrawn from the hub, the cartridge will jam. See 3-4. Cartridge Drive hub Adjustment, page 3-4.

3M Cartridge Switch (S5)--Actuates when a 3M Cartridge is inserted causing the threading sequence to be slightly different from that for ANSI Cartridges. Provides for earlier film slow down of 3M Cartridges near the end of the roll. If misadjusted or miswired, the end of roll sensing will be off. See Adjustment 3-10.4. 3M Cartridge Switch (S5), page 3-16.

6-3. THEORY OF OPERATION

Microprocessor

The Microprocessor for the M-654 is a typical microprocessor. It is spread over three printed wiring assemblies. The D140 Central Processing Unit, Clock and Reset Circuits, Address Decoder Circuit, D110 EPROM, D120 EPROM, and D130 RAM all located on the Processor PWA. The U260 I/O Ports, U270 I/O Ports, D240 Latch, U270 Digital to Analog Converter, U280 Multiplexer, Signal Process, and Noise Control are located on the Peripheral PWA. Three Pulse Width Modulators (N330, N360 and N350) are located on the Power PWA.

The Z80 CPU interprets and executes instructions. The EPROM or Erasable/Programmable Read Only Memory holds instructions that cannot be altered. RAM or Read and Write Memory (Random Access Memory) is used to store programs and information only while the M-654 is working. When power is removed RAM is wiped clean. The Clock coordinates the responses of the microprocessor's many circuits. The Multiplexer is a multiposition switch under the control of the CPU which allows for the selection of any one of a number of analog signals as the input to the Analog-to-Digital Converter. The Analog-to-Digital Converter changes continuous varying voltages into discrete on-off pulses. Once coded as binary pulses, information enters or leaves the microprocessor in parallel through the I/O Ports. The Latch maintains circuits on or off after switching has occurred and the triggering signal has been removed. Address codes travel on parallel circuits called the Address Bus. Information returns to the CPU on similar parallel circuits called the Data Bus. The Address Decoder help directs the electrical pulses to their correct destinations. The Signal Processors perform storage and time modulation of the input signals. The Noise Control cuts off all noise peaks stronger than the highest peak in the received signal. The Pulse Width Modulators control the on/off times of the pulses to the motors.

Power-On

At Power-On, the CPU initiates a system self-check. The Spindle Position Switch (S2)

checked to see that it is actuated and the Film Start Switch (S4), Film Sensor (S6) and that the Leader Sense Switch (S8) are deactuated. The Film Chute Solenoid (Y6) is actuated and deactuated to check for proper operation of the Film Chute. Either the Film Chute IN Switch (S9) or Film Chute OUT switch (S10) will cause an Error Code 1006 if not correct.

With power applied, the CPU constantly scans the condition of the switches through the I/O Ports for an on or off status, the relays for whether they are energized or deenergized, and the relative speed of the Film Reverse Motor and Film Advance Motor.

If the components are not in their expected state, the M-654 will react accordingly. For example, if a cartridge is loaded (Film Start Switch (S4) actuated) with no power applied, the Cartridge Eject Solenoid (Y2) will energize to release the latch on the Cartridge Side Plate. Spring pressure then moves the plate to the left ejecting the cartridge. The M-654 then initiates another self-check.

Or, if a cartridge is loaded but film has not been advanced (Film Start Switch (S4) on, Spindle Position Switch (S2) off, Film Sensor (S6) on, and Leader Sense Switch (S8) on) when the power goes out, the M-654 will drive the Film Reverse Motor (M1) to rewind film, deenergize the Spindle Release Solenoid (Y1) to engage the Worm Gear which withdraws the Spindle Shaft from the cartridge. When the Spindle Shaft is fully withdrawn, the Spindle Position Switch (S2) actuates signaling the Microprocessor to remove power from the Film Reverse Motor (M1) and energize the Cartridge Eject Solenoid (Y2) which releases the latch on the Cartridge Side Plate. Spring pressure then moves the plate to the left ejecting the cartridge. The M-654 then initiates another self-check.

Auto-Threading - 3M Type Cartridge

When a cartridge is inserted into the M-654, film is automatically threaded onto the Take-Up Reel and the Film Odometer reset to 0000. A set of routines stored in the CPU (D110, Rev. 15) controls the sequence and action.

Auto-Threading - 3M Type Cartridge (cont.)

As a film cartridge is pushed into the M-654 Cartridge Slot, the ANSI Hub pushes out actuating 3M Cartridge Switch (S5) when a 3M type cartridge is loaded. The state of 3M Cartridge Switch (S5) determines the 3M or ANSI Auto-thread Film Scan, and rewind/eject sequences. The Cartridge Side Plate is also moved to the right until it latches. The Cartridge Slide Plate actuates the Film Start Switch S4 which causes the Microprocessor to actuate the Spindle Release Solenoid (Y1). The Spindle Release Solenoid (Y1) releases the Spindle Shaft to be driven by spring pressure into the loaded film cartridge.

Then, control of the Film Reverse Motor (M1) and Film Advance Motor (M2) is removed from the manually turned Film Speed Control to the Microprocessor. The Film Reverse Motor (M1) runs counterclockwise one second to seat the Pawl within the hub and to tighten the leader on the film spool so that the Puck and Film Stripper can pick up the end of the leader from the cartridge. The Odometer Clutch (Y4) energizes to engage the Odometer Clutch to drive the Film Odometer Disc. The Glass Flat Solenoid (Y5) is energized to lower the Lower Glass Flat.

The Microprocessor then reduces power to the Film Reverse Motor (M1) to maintain film tension. The Swing Motor (M4) next drives the Puck Assembly toward the film cartridge until it is finally held against the film roll by spring pressure.

The Film Chute Solenoid (Y6) energizes to move the Film Chute in. After a short pause, the Microprocessor then starts the Film Advance Motor (M2). The Brake Solenoid (Y7) is energized to release the Brake. The Film Thread Motor (M3) runs to rotate the Puck against the film and Odometer Roller. The film is pulled from the cartridge by the Puck into the Film Guide, guided by Guide I, Guide II, Guide III and the Film Idler Roller, past the Film Sensor (S6), between the Glass Flats, along the Film Chute, and several wraps around the hub of the Take-Up Reel. The film is then held to the hub by friction as tension is applied.

As the film was driven past the Film Sensor (S6) it senses the film and signals the Microprocessor to drive the Swing Motor (M4) the other direction to move the Puck Assembly

away from the cartridge. Film is now driven by the Odometer Roller.

The Leader Sense Switch (S8) detects the beginning of the leader and starts a timer in the Microprocessor to drive the Film Advance Motor (M2) a predetermined length of time. As film is wrapped around the Film Take-Up Reel, the Motor Encoder Disc for the Film Advance Motor (M2) signals a speed change (1400 mm if film wrap has not been sensed) switching the Film Reverse Motor (M1) and Film Advance Motor (M2) to servo control. The Film Thread Motor (M3) is turned off and the Odometer Clutch Solenoid (Y4) deenergized to disengage the Odometer Clutch.

The Film Chute Solenoid (Y6) deenergizes to move the Film Chute back to its open position. Film is wound a fixed length determined by the Odometer Encoder Disc and controlled by the microprocessor. The length is determined by the actuation of the Leader Sense Switch (S8). The splicing tab for film having a leader stops under the Right Film Guide Roller.

The Film Reverse Motor (M1) is given a small voltage to run counterclockwise against the rotation of the Film Advance Motor (M1) to provide tension on the film as it is stopped at the preset maximum threading length. The Microprocessor passes control of the Film Reverse Motor (M1) and Film Advance Motor (M2) back to the manually turned Film Speed Control. The Film Odometer is automatically reset to 0000. The Brake Solenoid (Y7) is deenergized which then causes the Brake to be forced against the stationary disc by spring tension. The Film Clamp Solenoid (Y5) is deactuated causing the Lower Glass Flat to clamp by spring pressure.

Auto-Threading - ANSI Cartridge

Film from a cartridge inserted into the M-654 is automatically threaded onto the Take-Up Reel and the Film Odometer reset to 0000. A set of routines stored in the CPU (D110 Rev. 15) controls the sequence and action.

As a film cartridge is pushed into the M-654 Cartridge Slot, the Cartridge Side Plate is moved to the right until it latches.

Auto-Threading - ANSI Cartridge (cont.)

The Cartridge Slide Plate actuates the Film Start Switch (S4) which causes the Microprocessor to actuate the Spindle Release Solenoid (Y1). The Spindle Release Solenoid (Y1) releases the Spindle Shaft to be driven by spring pressure into the loaded film cartridge.

Then, control of the Film Reverse Motor (M1) and Film Advance Motor (M2) is removed from the manually turned Film Speed Control to the Microprocessor. The Film Reverse Motor (M1) runs counterclockwise two seconds to tighten the film on the film spool so that the Puck and Film Stripper can pick up the end of the film from the cartridge. The Odometer Clutch (Y4) energizes to engage the Odometer Clutch to drive the Film Odometer Disc. The Glass Flat Solenoid (Y5) is energized to lower the Lower Glass Flat.

The Microprocessor then reduces power to the Film Reverse Motor (M1) to maintain film tension. The Swing Motor (M4) next drives the Puck Assembly toward the film cartridge until it is finally held against the film roll by spring pressure.

The Film Chute Solenoid (Y6) energizes to move the Film Chute in. After a short pause, the Microprocessor then starts the Film Advance Motor (M2). The Brake Solenoid (Y7) is energized to release the Brake. The Film Thread Motor (M3) runs to rotate the Puck against the film and the Odometer Roller at 26% of full speed until Film Sensor (S6) is energized or for 3 seconds, whichever is first. The film is pulled from the cartridge by the Puck and driving Odometer Roller into the Film Guide, guided by Guide I, Guide II, Guide III and the Film Idler Roller, past the Film Sensor (S6), between the Glass Flats, along the Film Chute, and several wraps around the hub of the Take-Up Reel. The film is then held to the hub by friction as tension is applied.

As the film was driven past the Film Sensor (S6) it senses the film and signals the Microprocessor to drive the Swing Motor (M4) the other direction to move the Puck Assembly away from the cartridge. Film is now driven only by the Odometer Roller. Also, the Film Sensor (S6) signals the Thread-Up Motor (M3) to run at full speed.

As film is wrapped around the Film Take-Up Reel, the Motor Encoder Disc for the Film Advance Motor (M2) signals a speed change (1400 mm if film wrap has not been sensed) switching the Film Reverse Motor (M1) and Film Advance Motor (M2) to servo control. The Film Thread Motor (M3) is turned off and the Odometer Clutch Solenoid (Y4) deenergized to disengage the Odometer Clutch.

The Film Chute Solenoid (Y6) deenergizes to move the Film Chute back to its open position. Film is wound a fixed length determined by the Odometer Encoder Disc and controlled by the microprocessor.

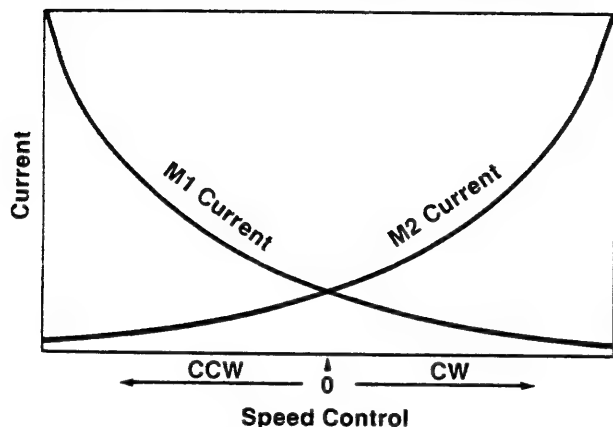
The Film Reverse Motor (M1) is given a small voltage to run counterclockwise against the rotation of the Film Advance Motor (M2) to provide tension on the film as it is stopped at the preset maximum threading length. The Microprocessor passes control of the Film Reverse Motor (M1) and Film Advance Motor (M2) back to the manually turned Film Speed Control. The Film Odometer is automatically reset to 0000. The Brake Solenoid (Y7) is deenergized which then causes the Brake to be forced against the stationary disc by spring tension. The Film Clamp Solenoid (Y5) is deactuated causing the Lower Glass Flat to clamp by spring pressure.

Film Scanning

Film Scanning is controlled by the manually turned Film Speed Control. As the Film Speed Control is rotated either direction from "0", signals are sent to the Film Reverse Motor (M1) and the Film Advance Motor (M2) to run in tandem. The Film Reverse Motor (M1) always runs counterclockwise and the Film Advance Motor (M2) always runs clockwise. When scanning is in the forward direction, the Film Reverse Motor (M1) receives a lower voltage than the Film Advance Motor (M2). In this case the Film Reverse Motor (M1) is the driving motor and the Film Advance Motor (M2) the dragging motor. When scanning in the reverse direction the opposite is true. The Film Advance Motor (M2) is the driving motor and the Film Reverse Motor (M1) is the dragging motor. No matter what the speed selection, the voltage is always higher for the driving motor than for the dragging motor. This differential maintains tension on the film by keeping it taut.

Film Scanning (cont.)

The graph below represents the power to the Film Reverse Motor (M1) and the Film Advance Motor (M2) during a forward or reverse film scan. Even when the Film Speed Control is at "0", there is current supplied to the motors. At "0", the two motors are in opposition until the film is completely stopped.



During a film scan, the motor receiving the higher current will determine the direction of film travel. The difference between the two will determine the speed.

When the Film Speed Control is at "0", the torque on the Film Reverse Motor (M1) and Film Advance Motor (M2) should balance and there should be no film movement. However, this exact balance is difficult to attain and maintain. Thus, the Brake on the Manual Scan Control Shaft actuates when the Film Speed Control is at "0" to ensure that the film does not move.

The scan speed of the film and its direction of travel, are determined by the rotational position of the Film Speed Control. The further the Film Speed Control is rotated away from the "0" neutral position, the faster the scan rate. The direction the Film Speed Control is rotated determines the direction of the scan. Rotating the Speed control clockwise from "0" advances the film while turning it counterclockwise reverses its travel.

The Odometer Encoder Disc controls the variable speed of the motors. This variable motor speed keeps the film speed across the glass flats constant even though the diameter of the film roll is constantly changing.

This transparent encoder disc has a large number of radial lines along its edge and is driven by the film as it advances or reverses. An optical switch, the Odometer Sensor (S7), is pulsed by the flashes of light between the lines on the disc. The Odometer Sensor (S7) actually consists of two photosensors, one slightly ahead of the other. Direction of disc rotation is determined by which sensor is pulsed first. The width of the pulses is proportional to the film speed and is compared to a fixed pulse width corresponding to the position of the Film Speed Control. The difference between the fixed pulse width and the pulse width generated by the film is used to control the motor speed.

The number of pulses also determines the changing count on the Odometer Display. The number displayed is a relative indication of linear film travel. The Odometer Display is not calibrated in millimeters or inches (100 feet equal 2360 digits of the display).

The Odometer Display is used as a reference to locate a given frame of film at a later time.

The Film Reverse Motor (M1) and Film Advance Motor (M2) are driven by voltage pulses at a constant amplitude. The width of the pulses determines the speed of the motors. The wider the pulses, the greater the amount of energy transferred, consequently, the higher the speed. If the comparator finds the film speed too low, it signals for one of the Pulse Width Modulators on the Power PWA to increase the width of the pulses to the driving motor, thus increasing its speed. If the film speed is too high, a narrower pulse width is signaled.

The Encoder Disc and optical Reverse Motor Speed Sensor (S3) determines when the end of the film on the supply reel is approaching. The width of the pulses generated by the Reverse Motor Speed Sensor (S3) is compared to the width of the pulses generated by the Odometer Disc. The ratio of the two accurately predicts the end of the film. When the ratio reaches a predetermined level, the Microprocessor will automatically slow the scan rate as the end of the film on the reel approaches. This prevents the film from

Film Scanning (cont.)

being pulled completely out of the cartridge or breaking if film is scanned all the way to the end of the reel.

The approach of the film end is gauged by the diameter of the film left on the reel. For this reason, reels with fillers should not be used on the M-654. With the additional diameter of a filler, the unit does not sense the approach to the film end. Scan rate is not slowed, and broken film may result.

The pulses generated by the Encoder Disc of the dragging motor, either M1 or M2, are used in a governor circuit to limit the current drawn by the machine. The film speed is smoothly variable from 0.02 in./sec to 10 ft/sec. When film speed increases between 1.18 in. and 1.97 in./sec, the Film Clamp Solenoid (Y5) energizes, opening the glass flats which are closed at lower speeds. The open glass flats reduces the potential for scratches on the film and the glass as it passes between them at high speeds.

The M-654 film drive system is very efficient because the dragging motor acts as a generator or tachometer. The power produced by the dragging motor is used to supplement the requirements of the driving motor.

Film Rewinding

The M-654 will automatically rewind film and eject the film cartridge when the operator turns the Film Speed Control counterclockwise from its "0" position and left there until the sequence has been completed. The M-654 will also automatically rewind film and eject the cartridge if any one of a number of abnormalities exist. The sequence of events is the same for either case. This discussion will only consider the sequence during a manually initiated rewind/eject routine. A manual rewind/eject sequence is initiated by the operator by rotating the Film Speed Control counterclockwise (usually fully counterclockwise to save time) from "0". Reverse film scan continues at the speed selected until the approach of the end of film is sensed. The ratio of the count between the Odometer Encoder Disc and the Motor Encoder Disc for the Rewind Motor (M1) is compared to calculate the diameter of the film roll. When a predetermined value is reached, the M-654 Microprocessor:

- Takes over control of the Film Reverse Motor (M1) and Film Advance Motor (M2) from the Film Speed Control.
- Reduces the speed of the Film Reverse Motor (M1).
- Deenergizes Spindle Release Solenoid (Y1) capturing the Worm Gear on the end of the Spindle Shaft.

As the Film Reverse Motor (M1) continues to drive, the Worm Gear withdraws the Spindle Shaft from the film cartridge. When the Spindle Shaft is fully withdrawn, it actuates the Spindle Position Switch (S2).

With the Spindle Position Switch (S2) actuated, the M-654 Microprocessor:

- Removes Power from the Film Reverse Motor (M1).
- Energizes the Cartridge Eject Solenoid (Y2) which release the latch on the Cartridge Side Plate. Spring Pressure then moves the plate to the left, ejecting the film cartridge.

After the film cartridge has been ejected, the M-654 Microprocessor:

- Checks that the Puck Assembly is withdrawn.
- Deenergizes all motors.
- Deenergizes all solenoids.
- Checks that all switches are in their proper states.

If an abnormality occurs, the M-654 Microprocessor immediately takes control of the Film Rewind Motor (M1) and Film Advance Motor (M2) instead of waiting for the film end to be sensed.

Diagnostics

The same microprocessor that controls the 4-digit LED Display that acts as a film odometer and displays error codes also uses the display to indicate specific components of the M-654 and their condition or test output value. The M-654 is capable of checking the status and function of all its switches, solenoids, and motors.

The M-654 Diagnostic Mode is selected with the Service Switch on the upper right corner of the Peripheral PWA. The Service Switch has four slide switches with ON/OFF options, but only Slide 1 is active.

Diagnostics (cont).

When Slide 1 is in the ON position, the M-654 is in the normal Operating Mode. When Slide 1 is in the OFF position, the M-654 is in the Diagnostic Mode.

When the Service Switch is in the Diagnostic Mode, a flashing 2-digit number will appear on the LED display. Normally the Film Speed Control will be at its "0" position which will cause a flashing "31" to appear. Rotating the Film Speed Control either direction will select, by code, the component to be checked.

For all Diagnostics except switches, pressing the Reset Switch (S1) will "lock" the microprocessor to hold the component to be checked while the Film Speed Control is turned to program a test output value.

Rotating the Film Speed Control fully counter clockwise will program the microprocessor to display a flashing "00". Turning the Speed Control clockwise will then program a test output value for motors or solenoids.

Diagnostic Codes 1 through 11 are used to show the status of switches 1 through 12. The rightmost digit of the LED display will show a "0" for an electrically open switch circuit and a "1" for an electrically closed switch circuit. Manually operating the microswitch selected should change the status of the display. The Reverse Motor Speed Sensor (S3) and Advance Motor Speed Sensor (S11) are checked by very slowly turning the appropriate Encoder Disk while watching the display. The display should alternately "0" and "1". The Film Sensor (S6) can be checked by blocking and unblocking the light path of the reflective sensor with a piece of unexposed negative film. A "1" will display when the sensor is blocked. The Odometer Sensors (S7) are checked in the same way as the microswitches but the display will be different. The display in this case should be "11" to indicate that neither the forward or reverse sensing circuit is open. A "10", "00", or "01" would indicate a defective sensor(s). In earlier M-654s, the Cartridge Jam Switch is checked by turning the Film Speed Control to a "04" display as if checking the Film Start Switch (S4).

By manually actuating and holding the Film Start Switch (S4), manually actuate the Cartridge Jam Switch (S12) noting the change in the LED display. In current M-654s, Diagnostic Code 12 works independently with the Cartridge jam Switch (S12).

Diagnostic Codes 13 and 14 are presently not used.

Diagnostic Codes 15 and 16 are used to check "counting" of the motor speed sensors. By very slowly rotating the Encoder Disk for the selected sensor, the LED display should decrease in value or remain constant depending on the direction of rotation.

Diagnostic Codes 17 through 19 are used to check "counting" of the Odometer Sensors. As you very slowly rotate the Encoder Disk for the selected sensor, the display should increase or decrease in value depending on the direction of rotation.

Diagnostic Code 20 can be used to check the function of any switch or counter without having to reposition the Speed Control. With Diagnostic Code "20" flashing on the LED display, the right side of the display will be blank until a switch is manually actuated. The number of the switch actuated will briefly appear in the right side of the display.

Diagnostic Codes 21 and 22 are not presently used.

Diagnostic Code 23 and 53 are used to read and display the M-656 Page Search Speed Input Enable command and M-656 outputs. These functions will be discussed in the Theory of Operation for the M-656 Page Search.

Diagnostic Code 24 shows the revision level of D110 EPROM if Rev. 10 or higher.

Diagnostic Codes 25 through 27 indicate the revision date of the D110 EPROM on the M-654 Processor PWA. Code 25 will display the day, Code 26 will display the month, and Code 27, the year.

Diagnostics (cont).

Diagnostic Codes 28 through 30 indicate the date of the revision for the D120 EPROM on the Processor PWA. Code 28 will display the day, Code 29 will display the month, and Code 30, the year.

Diagnostic Codes 31 through 37 are used to check the solenoids. When the Film Speed Control has been turned to display the

Diagnostic Code for the selected solenoid, the Reset Button must be pushed to "lock" the microprocessor to that function. The Film Speed Control should then be turned fully counterclockwise until the display flashes "00". The Film Speed Control should then be turned clockwise to the selected test output value. The test output value can be from "00" to "08" but solenoids should actuate at "06". These numbers represent a voltage pulse width to the solenoids. Pressing the Reset Switch (S1) will then actuate the selected solenoid to drive the mechanical components. Do not hold the solenoids energized too long or the Thermistor will open.

Diagnostic Codes 38 through 43 are used to check the motors. Similar to checking solenoids, when the Film Speed Control has been turned to display the Diagnostic Code for the selected motor, the Reset Button must be pushed to "lock" the microprocessor to that function. The Film Speed Control should then be turned fully counterclockwise until the display flashes "00". Diagnostic Code 40 is used to drive the Film Reverse Motor (M1) clockwise. Diagnostic Code 41 is used to drive the Film Reverse Motor (M1) counterclockwise. With new Power PWAs, both codes will run the motor counterclockwise. Diagnostic Codes 40 and 41 also energize the Spindle Release Solenoid (Y1) so the motor will turn freely (If the Spindle is retracted, M1 is physically prevented from turning until Y1 is energized to release it). Diagnostic Code 42 is used to check the Film Advance Motor (M2). Diagnostic Code 42 also energizes the Brake Solenoid (Y7) to release the Brake. The motor will run even if the Brake is not released, but a more accurate indication of the motor function is obtained with it running freely. The Film Speed Control should then be turned clockwise to the selected test output value.

The test output value can be from "00" to "99" but motors should run at "25". These numbers represent a percentage of the rated current to the Film Reverse Motor (M1), Film Advance Motor (M2), and Film Thread Motor (M3). These numbers represent a voltage pulse width to Swing Motor (M4). The Swing Motor (M4) should run at a setting of "03". The other motors should stall at 10% to 15% of the rated current. The motors should not be run at more than 50 percent. Pressing the Reset Switch (S1) will then run the selected motor until the Reset Switch is released. The selected power level may be varied as the motor is energized.

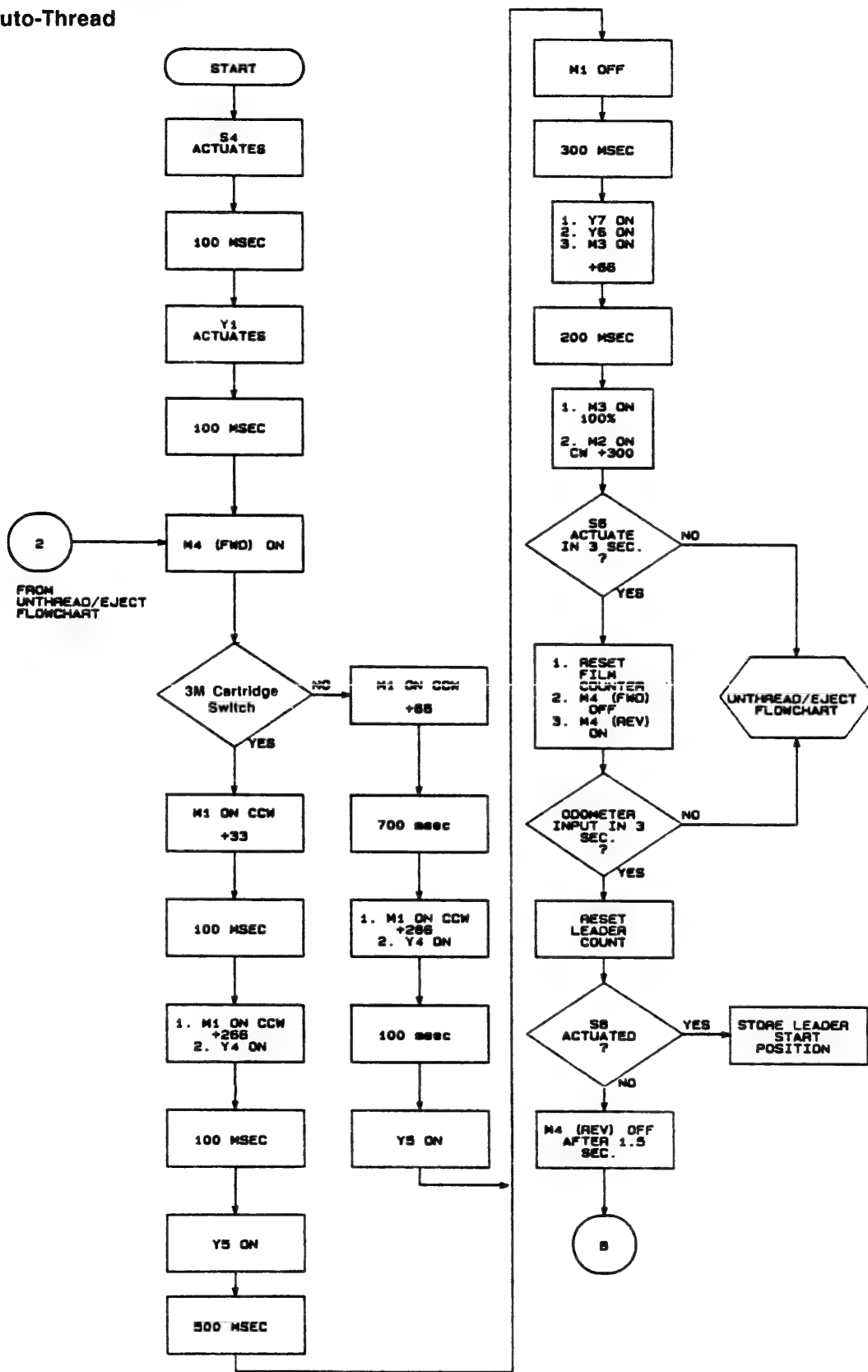
Diagnostic Code 47 is used to run the Encoder Disc by running the Thread Motor (M3) and actuating the Odometer Clutch Solenoid (Y4). This allows checking of the engagement of the Odometer Clutch as the Thread Motor (M3) drives the Odometer Disk. After Diagnostic Code 47 has been selected the Speed Control must be turned fully counterclockwise until a flashing "64" appears on the LED display. Then rotate the Speed Control clockwise until "0000" appears in the LED display. Next, press the Reset Switch (S1) to power the Thread Motor (M3) and Clutch Solenoid (Y3). Do not run the motor too long or the Thermistor will open.

To change from one diagnostic select mode to another, simply rotate the Film Speed Control fully counterclockwise for a "00" LED display and press the Reset Switch (S1) twice. The LED will flash "00". Turn the Film Speed Control clockwise to the next desired Diagnostic code for the selected component and repeat the process.

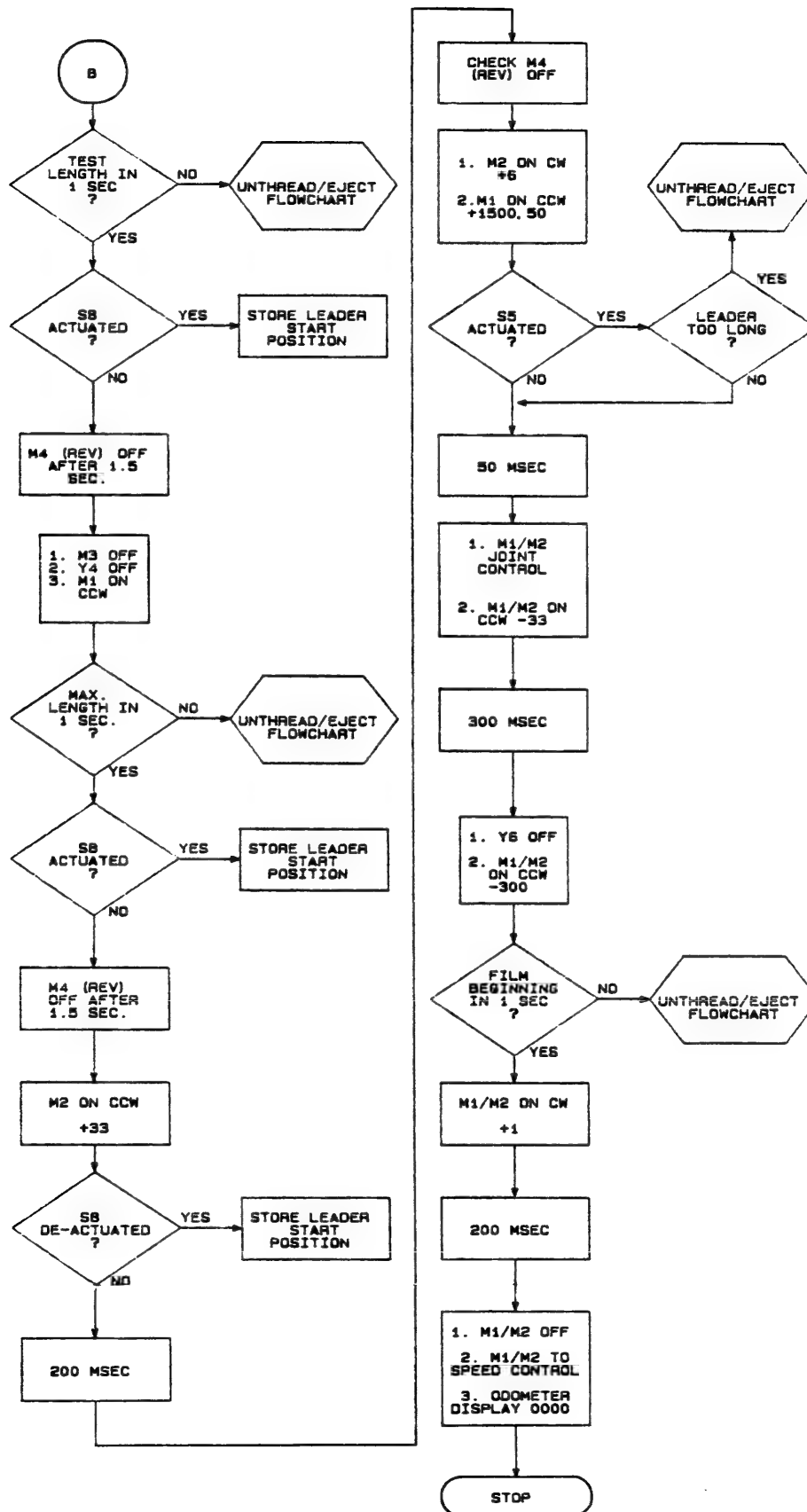
To return to normal operation, simply move Slide 1 of the Service Switch to ON.

6-4. FLOW DIAGRAMS

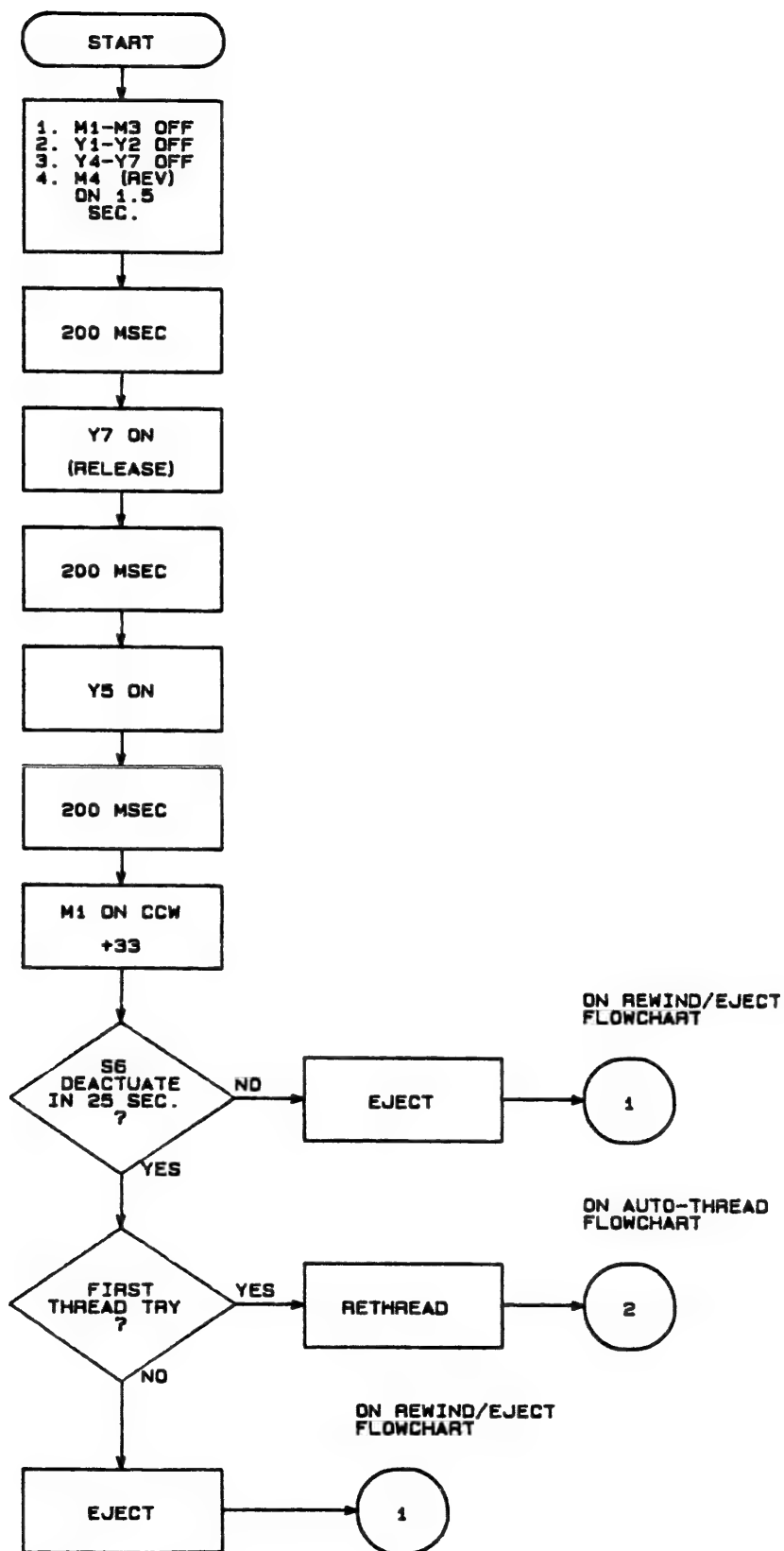
Auto-Thread



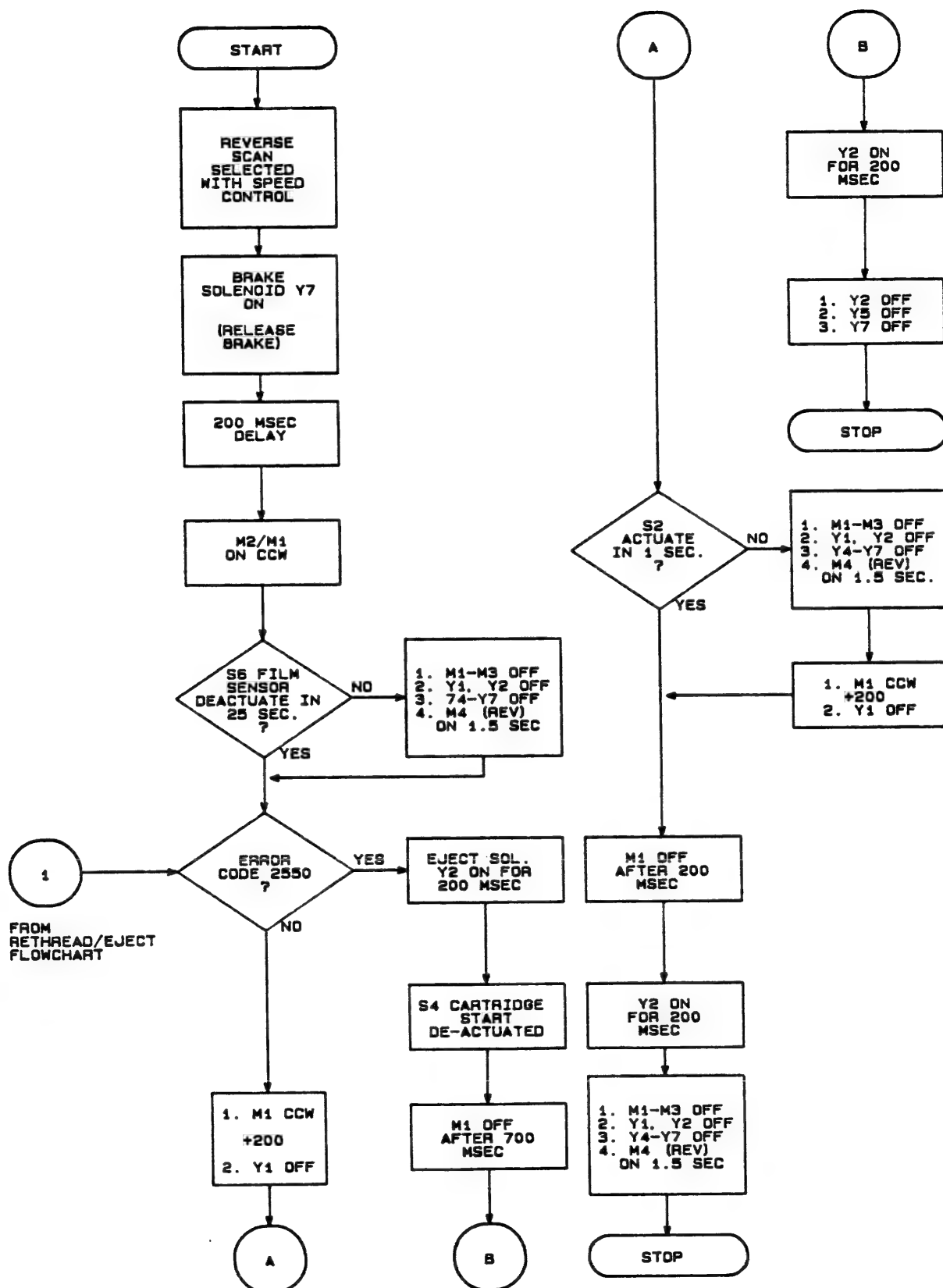
Auto-Thread (cont.)



Rewind/Eject



Unthread/Eject

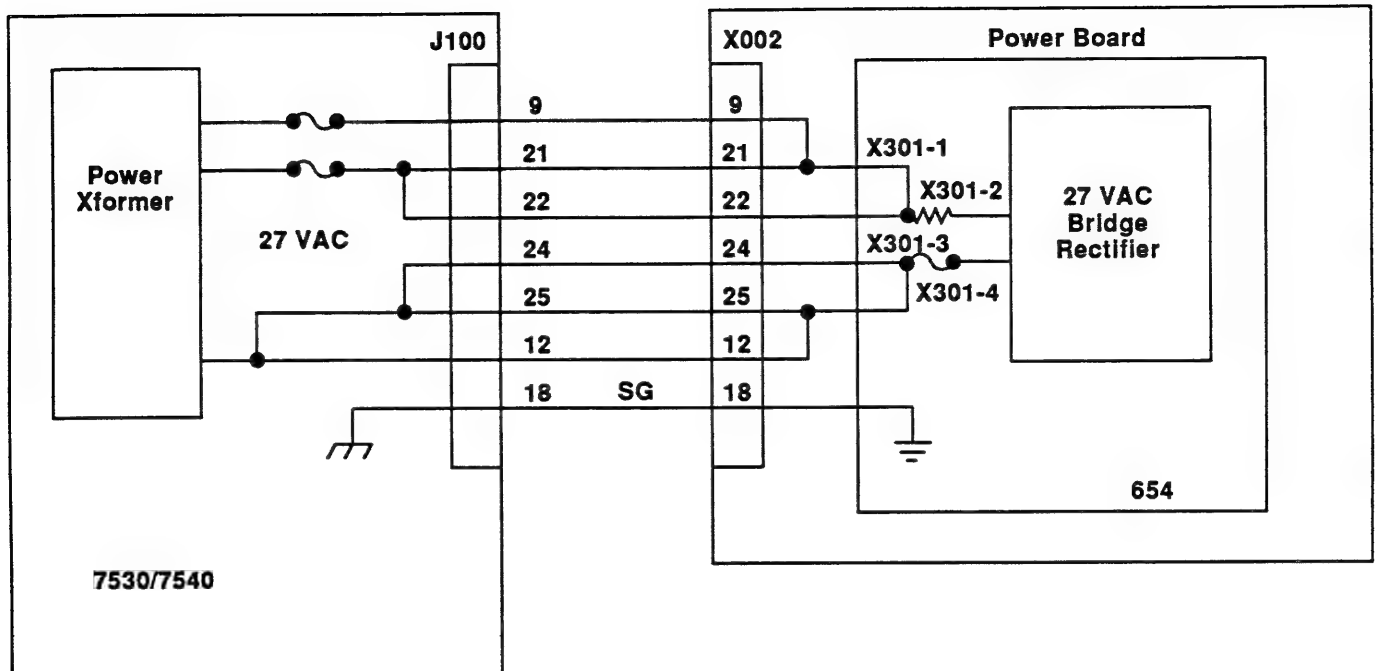


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* Located in the binder pocket

7-4. SYSTEM BLOCK DIAGRAM

7-5. FUNCTIONAL SCHEMATIC
(Located in binder pocket)

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8-1. ERROR CODES

When a malfunction occurs in the M-654, a one-digit Category Number will display in the Odometer/Status--Error Display and the machine will be disabled. Press the Odometer Reset Button to display a four-digit Error Code. The Error Code helps identify the cause of the malfunction and the result of the malfunction that is preventing normal operation. If an unlisted Error Code is displayed, find the last three digits of the Error Code under another category or the Error Code immediately before it. The cause and result will be similar.

Category	Error Code	Cause	Result
Category 1	1002	Electrical Noise initiated EPROM res.	Push Reset Switch.
	1006	Thermofuse Circuit is open at Power ON.	See page 8-17. Push Reset Switch.
	1009	Film Chute is jammed <u>out</u> , or Film Chute In Switch (S9) is not operating.	See page 8-8.
	1010	Film Chute is jammed <u>in</u> , or Film Chute Out Switch (S10) is not operating.	See page 8-8.
	1080	Leader Sense Switch (S8) is actuated at Power ON, but Film Start Switch (S4) is not.	Push Reset Switch. See page 8-9.
	1311	Film Sensor (S6) is not sensing film during the first attempt to auto-thread. Film Thread Motor (M3) Circuit is open or Odometer Clutch Solenoid (Y4) is open.	Reinserting the Cartridge cancels the Display. See page 8-10.
	1331	Minimum film length was not reached during first attempt to auto-thread. Odometer Sensor (S7) Circuit is open.	Reinserting the Cartridge cancels the Display. See page 8-10.
	1356	Film Advance Motor (M2) Circuit is open.	Reinserting the Cartridge cancels the Display. See page 8-10.
	1411	Film Start was not recognized during rewind of first attempt to auto-thread.	Reinserting the Cartridge cancels the display. See page 8-10.
	1605	Thermofuse Circuit is open (other than at Power ON).	Display remains until Power is removed. See page 8-11.
	1706	Film has broken or pulled loose from the Film Cartridge Spool. Film Sensor (S6) has opened. Advance Motor Speed Sensor (S11) is open.	Display remains until Power is removed. See page 8-13.
	1709	Film Chute IN Switch (S9) is actuated after auto-thread is completed. after rewind.	Reinserting the Cartridge cancels the Display. See page 8-11.
	1710	Film Chute OUT Switch (S10) does not actuate after auto-thread is completed.	Push Reset Switch to cancel the Display. See page 8-11.
	1712	Film Reverse Motor (M1) or Film Advance Motor (M2) stop during a film scan. Odometer Sensor (S7) Circuit is open.	Display remains until Power is removed. See pages 8-13, 8-14.
	1720	Spindle Release Solenoid (Y1) releases during a film scan operation or opens when auto-threading.	Reinserting the Cartridge cancels the Display. See pages 8-7, 8-11, 8-13.
	1721	Spindle Release Solenoid (Y1) does not release after rewind.	No automatic Cartridge eject after rewind. See page 8-14.

8-1. ERROR CODES (Continued)

Category	Error Code	Cause	Result
Category 2	2006	Film Sensor (S6) senses film at Power ON, but Film Start Switch (S4) is not actuated.	Reinserting the Cartridge cancels the Display. See page 8-9.
	2310	Film Sensor (S6) did not actuate during the second attempt to auto-thread.	Reinserting the Cartridge cancels the Display. See page 8-11.
	2330	Odometer did not sense minimum film travel during the second attempt to auto-thread.	Reinserting the Cartridge cancels the Display. See page 8-11.
	2335	Odometer did not sense maximum film travel during the second attempt to auto-thread.	Reinserting the Cartridge cancels the Display. See page 8-11.
	2365	Leader Sense Switch (S8) is still actuated at maximum length during the second attempt to auto-thread.	Reinserting the Cartridge cancels the Display. See page 8-11.
	2397	Insufficient film feed during auto-thread because the Film Chute is not in the proper position (Film Chute IN Switch S9 is not actuated).	Reinserting the Cartridge cancels the Display. See page 8-12.
	2398	Insufficient film feed during auto-thread because the Film Chute is not in the proper position (Film Chute OUT Switch S10 is not deactuated).	Reinserting the Cartridge cancels the Display. See page 8-12.
	2399	Film does not wrap and hold on Film Take-Up Reel. A diameter calculation error is sensed.	Reinserting the Cartridge cancels the Display. See page 8-12.
	2410	Film Start Position was not recognized during rewind following the second attempt to auto-thread.	Reinserting the Cartridge cancels the Display. See page 8-12.
	2499	Film has pulled loose from the Take-Up Reel during rewind to the Start Position after auto-thread. A diameter calculation error is sensed.	Reinserting the Cartridge cancels the Display. See page 8-12.
Category 3	3001	Odometer Reset Switch (S1) is actuated at Power ON.	Display remains until Power is removed. See page 8-8.
	3002	Spindle Position Switch (S2) is not actuated at Power ON.	Display remains until Power is removed. See page 8-8.
	3009	Film Chute IN Switch (S9) is actuated at Power ON.	Display remains until Power is removed. See page 8-8.
	3010	Film Chute OUT Switch (S10) is deactuated at Power ON.	Display remains until Power is removed. See page 8-8.
	3084	Film Sensor (S6) is not sensing film at Power ON even though Film Start Switch (S4) and Leader Sense Switch (S8) are actuated.	Display remains until Power is removed. See page 8-9.
	3550	Film Sensor (S6) is actuated but does not deactuate within 25 seconds of starting a rewind routine.	No automatic Cartridge eject after rewind. See page 8-14.

8-1. ERROR CODES (Continued)

Category	Error Code	Cause	Result
Category 3 continued	3551	Film Reverse Motor (M1) stops during rewind before Film Sensor (S6) de-actuates. Film Reverse Motor (M1) Circuit is open.	No automatic Cartridge eject after rewind. See pages 8-10, 8-14.
	3555	Film Reverse Motor (M1) stops during rewind after Film Sensor (S6) deactuates. Reverse Motor Speed Sensor (S3) Circuit is open.	No automatic Cartridge eject after rewind. See pages 8-10, 8-14.
	3570	Film Reverse Motor (M1) jams before Spindle is retracted.	No automatic Cartridge eject after rewind. See page 8-14.
	3575	The Spindle has not been fully retracted after rewind.	No automatic Cartridge eject after rewind. See page 8-14.
	3709	Film Chute IN Switch is actuated after auto-thread is completed.	No automatic Cartridge eject after rewind.

8-2. DIAGNOSTIC CODES

Diagnostic Codes for the M-654 consist of two-digit numbers that appear on the Film Odometer/Status--Error Display when the Service Switch is switched to the OFF position. When a Diagnostic Code is displayed the status of the designated switch can be determined, the designated solenoid can be activated, or the designated motor can be run. Use the following procedure to enter, use and exit the Diagnostic Mode:

1. Switch ON the Reader-Printer, rewind film and remove the Film Cartridge.
2. Switch OFF the Reader-Printer.
3. Disconnect and remove the M-654.
4. Remove the Rear and Top Left Covers.
5. Switch OFF the Service Switch.
6. Reconnect the M-654 and switch ON the Reader-Printer.
7. Turn the Film Speed Control clockwise to increase the Diagnostic Code (see Diagnostic Table) or counterclockwise to decrease.

Switches

- a. Manually actuate the switch. The Display will change if the switch is functioning correctly.
- b. Manually deactuate the switch. The display will change if the switch is functioning correctly.

Counters

Turn the Encoder Disk. The values should change depending on the Diagnostic Code selected.

Solenoids

- a. At the designated code, push the Reset Button.
- b. Turn the Film Speed Control fully counterclockwise.
- c. Turn the Film Speed Control clockwise to increase the output voltage. (04 = 50%, 08 = 100%)
- d. Push the Reset Button to activate the designated solenoid.
- e. To remain in the Diagnostic Mode and change to a different Diagnostic Code, turn the Film Speed Control fully counterclockwise. Then push the Reset Button twice and turn the Film Speed Control clockwise to the desired Diagnostic Code.

Motors

- a. At the designated code, push the Reset Button.
 - b. Turn the Film Speed Control fully counterclockwise.
 - c. Turn the Film Speed Control clockwise to increase the output voltage.
 - d. Push the Reset Button to activate the designated motor.
 - e. To remain in the Diagnostic Mode and change to a different Diagnostic Code, turn the Film Speed Control fully counterclockwise. Then push the Reset Button twice and turn the Film Speed Control clockwise to the desired Diagnostic Code.
8. To leave the Diagnostic Mode, switch ON the Service Switch.

Diagnostic Code—

3100

Flashing—Blank

Diagnostic Code—

XX00

Steady—Blank

Diagnostic Code—

XX0X -0 - OFF, 1 - ON

Flashing—Steady
Blank

Diagnostic Code—

XX00 -Counter Value

Flashing—Steady

Diagnostic Code—

XX00 -00 - 08

Steady—Flashing

Solenoids
should activate
at 08

Diagnostic Code—

XX00 -00 - 99(%)

Steady—Steady

Motors should
run at about
10 to 25.
(Swing Motor
at about 06
to 08).

0000
Flashing—Blank

8-2. DIAGNOSTIC CODES (Continued)

Code	Checks	Procedure
SWITCHES		
01	Odometer Reset Switch S1	Press Reset Button. Display should go from 0 to 1.
02	Spindle Position Switch S2	Raise the Spindle Release Solenoid (Y1) plunger. Display goes from 1 to 0.
03	Reverse Motor Speed Sensor S3	Turn M1 Encoder Disk. Display toggles 1 to 0 to 1, etc.
04	Film Start Switch S4	Press in switch actuator. Display goes from 0 to 1.
05	3M Cartridge Switch S5	Operate switch actuator. Display goes from 0 to 1.
06	Film Sensor S6	Slide film under sensor. Display goes 0 to 1.
07	Odometer Sensor S7 outputs	Observe Display for steady 11 indication (no change).
08	Leader Sense Switch S8	Press in switch actuator. Display goes 0 to 1.
09	Film Chute In Switch S9	Actuate switch. Display goes 0 to 1.
10	Film Chute Out Switch S10	Actuate switch. Display goes 1 to 0.
11	Advance Motor Speed Sensor S11	Turn M2 Encoder Disk. Display toggles 1 to 0 to 1, etc.
12	Cartridge Jam Switch (S12) after S/N 5401070	Actuate Switch, Display goes from 0 to 1.
COUNTERS		
15	Film Reverse Motor M1 Speed Counter	Turn M1 Encoder Disk. Observe Display for count decrease (in either direction).
16	Film Advance Motor M2 Speed Counter	Turn M2 Encoder Disk. Observe Display for count decrease (in either direction).
17	Odometer Count forward	Turn Odometer Disk CCW. Count should not change. Turn disk CW. Count should decrease.
18	Odometer Count backward	Turn Odometer Disk CW. Count should not change. Turn disk CCW. Count should decrease.
19	Odometer Count	Turn Odometer Disk CW. Count should increase. Turn disk CCW. Count should decrease.
20	Any manually actuated switch	Actuate a switch or sensor. Switch number displays.
23	Speed Control Lines from M-656	See procedure on next page for using code 23.
24	D110 EPROM Revision Level after Rev. 10	Check Revision Level on Display.
25	D110 EPROM Version (Day)	Check date on Display.
26	D110 EPROM Version (Month)	Check date on Display.
27	D110 EPROM Version (Year)	Check date on Display.
28	D210 EPROM Version (Day)	Check date on Display.
29	D210 EPROM Version (Month)	Check date on Display.
30	D210 EPROM Version (Year)	Check date on Display.
SOLENOIDS (SEE PROCEDURE FOR CHECK ON PRECEDING PAGE.)		
31*	Spindle Release Solenoid Y1	Check that solenoid actuates at about 06, deactuates about 01.
32*	Cartridge Eject Solenoid Y2	Check that solenoid actuates at about 06, deactuates about 02.
34*	Odometer Clutch Solenoid Y4	Check that solenoid actuates at about 06, deactuates about 04.
35*	Film Clamp Solenoid Y5	Check that solenoid actuates at about 06, deactuates about 02.
36*	Film Chute Solenoid Y6	Check that solenoid actuates at about 06, deactuates about 04.
37*	Brake Solenoid Y7	Check that solenoid actuates at about 06, deactuates about 02.
38**	Swing Motor M4 (into Cartridge)	Check that M4 drives puck in (at about 03 output).
39**	Swing Motor M4 (out of Cartridge)	Check that M4 drives puck out (at about 03 output).
	* Avoid thermal overloading.	
	** Swing Motor (See Solenoid Procedure for check on preceding page).	

8-2. DIAGNOSTIC CODES (Continued)

Code	Checks	Procedure
MOTORS (SEE PROCEDURE FOR CHECK ON PAGE 8-4.)		
40*	Film Reverse Motor M1 and Spindle Release Solenoid Y1 up	Check M1 CCW operation, observed from front (at about 12 output); and Y1 actuates.
41*	Film Reverse Motor M1 and Spindle Release Solenoid Y1 up	Check M1 CW operation, observed from front (at about 12 output); and Y1 actuates.
42*	Film Advance Motor M2 and Brake Solenoid Y7 open	Check M2 CW operation, observed from front (at about 12 output).
43*	Film Thread Motor M3	Check M3 operation (at about 15 output).
47	Odometer Disk drive (Odometer Clutch Solenoid Y4 and Film Thread Motor M3).	Turn film Speed Control completely CCW to 4764, then CW to 0000. Press Reset again to start drive, Press Reset again to stop drive.
50**	Film Reverse Motor M1 CCW	Check M1 CCW operation, observed from front (stalls about 10 output, runs about 15 output).
51**	Film Reverse Motor M1 CW	Check M1 CW operation, observed from front (stalls about 10 output, runs about 15 output).
52**	Film Advance Motor M2	Check M2 operation (stalls about 10 output, runs about 15 output).
53	Command lines from M-654 to M-656	See procedure on page 8-6 for using code 53.
	* Avoid thermal overloading.	
	** To run motors without a load, use 40, 41, and 42 rather than 50, 51, and 52 respectively.	

Procedure for Using Diagnostic Code 23

1. From the M-656 Keyboard, send a Film Speed Control Command to the M-654 as follows:
 - a. Key in 3597 L to enter the M-656 diagnostic mode.
 - b. Enter one of the following speed control commands:

● For Low Speed Forward (LSF), enter	1301 L.
● For Medium Speed Forward (MSF), enter	1302 L.
● For High Speed Forward (HSF), enter	1303 L.
● For Low Speed Reverse (LSR), enter	1304 L.
● For Medium Speed Reverse (MSR), enter	1305 L.
● For High Speed Reverse (HSR), enter	1306 L.
● For Low-Medium Speed Forward (L-MSF), enter	1307 L.
2. At the M-656, check reception of the command as follows:
 - a. Enter the M-654 Diagnostic Mode (see page 8-4).
 - b. Turn the Film Speed Control to 23.
 - c. Press the Reset Button and observe the two rightmost digits on the Display. These indicate reception of signals from the M-656 as follows:
 - 09 indicates S AVAIL and LSF (Searcher Available and Low Speed Forward) are active.
 - 10 indicates S AVAIL and MSF.
 - 11 indicates S AVAIL and HSF.
 - 12 indicates S AVAIL and LSR.
 - 13 indicates S AVAIL and MSR.
 - 14 indicates S AVAIL and HSR.
 - 15 indicates S AVAIL and L-MSF.

8-2. DIAGNOSTIC CODES (Continued)**Procedure for Using Diagnostic Code 53**

1. At the M-654, prepare to send test signals to the M-656 as follows:

- a. Enter the Diagnostic Mode and select Diagnostic Code 53 (see page 8-5a).
- b. Press the Reset Button and turn the Film Speed Control fully CCW.
- c. Turn the Speed Control CW to select the desired signal(s) to be sent to the M-656. From fully CCW to center-point of the control, five (0 to 4) single-digit numbers can be selected. Each of these selects a particular signal as follows:

0 = CTRG (Cartridge), 1 = FILM LOADED, 2 = XPORT N AVAIL, 3 = END OF FILM, 4 = ERROR

If you turn the control CW past center-point, double-digit numbers from 00 to 31 will appear. These can be used to send combinations of signals to the M-656. For this purpose each of the five signals carries a numeric value, as shown below. To select a combination of signals, simply add the numeric values of the desired signals as shown in the examples below.

CTRG (Cartridge) = 1
FILM LOADED = 2
XPORT N AVAIL = 4
END OF FILM = 8
ERROR = 16

For Example:

- a. To send CTRG only, select 1.
- b. To send CTRG and ERROR, select 17.
- c. To send FILM LOADED, XPORT N AVAIL, and END OF FILM, select 14.
- d. To send all signals, select 31.

Note

The selected signals will be sent to the M-656 when the M-654 Reset Button is pressed at the end of the following step.

2. At the M-656, monitor reception of the signal(s) at the L/O ports as follows:

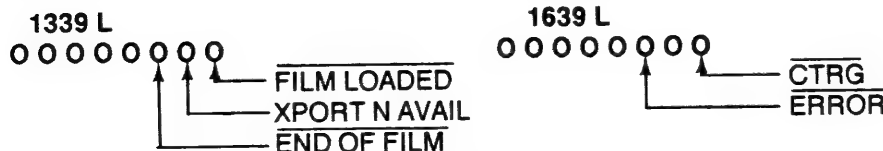
- a. At the M-656 Keyboard, enter the M-656 Diagnostic Mode by keying in 3597 L.
- b. To view an individual signal line, enter the code number for the desired diagnostic port as follows. (The level of the selected signal will show on the rightmost digit of the M-656 Display.)

- For CTRG, enter 1630 L.
- For FILM LOADED, enter 1330 L.
- For XPORT N AVAIL, enter 1331 L.
- For END OF FILM, enter 1332 L.
- For ERROR, enter 1632 L.

Note:

In some machines, Error Code 63 will display when a particular port is selected. This is a software error that will be corrected. If this error occurs, you can check the signal by using the code that displays the entire port, as described in step c below.

- c. To monitor signals simultaneously, enter the code number that displays an entire M-656 Port. These codes, 1339 L and 1639 L, display signals as shown below:



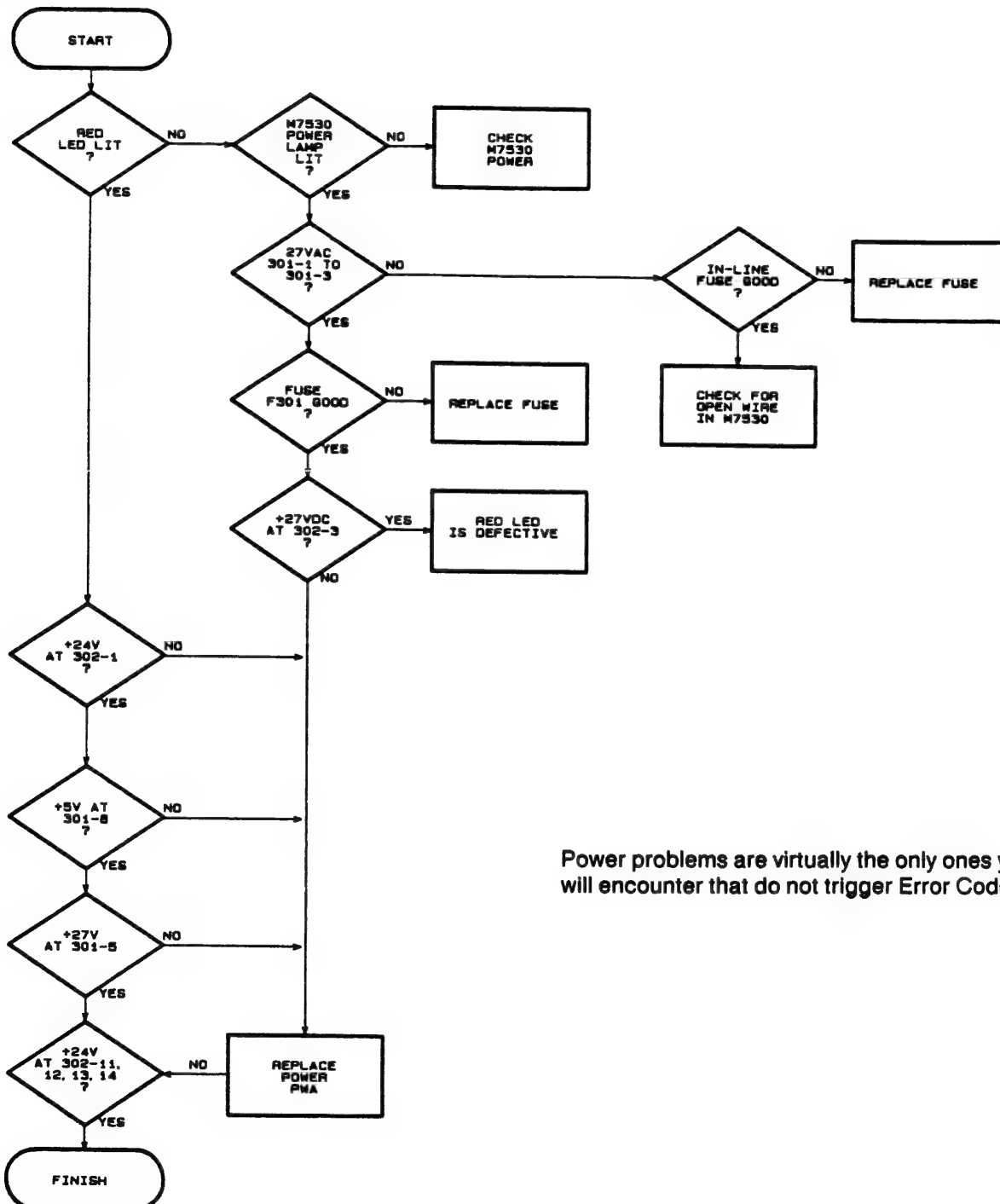
- d. Press the Reset Button on the M-654 to send the signal(s) to the M-656, and monitor the M-656 Display for the level of the signal(s). The active level for each signal should be 0, except for XPORT N AVAIL, which is 1.

8-3. TROUBLESHOOTING FLOWCHARTS

8-3.1. General

For the sake of brevity in the construction of the Troubleshooting Flowcharts, continuity through all connectors and wires is assumed good. Continuity should, of course, be verified before judging a component defective.

8-3.2. Power



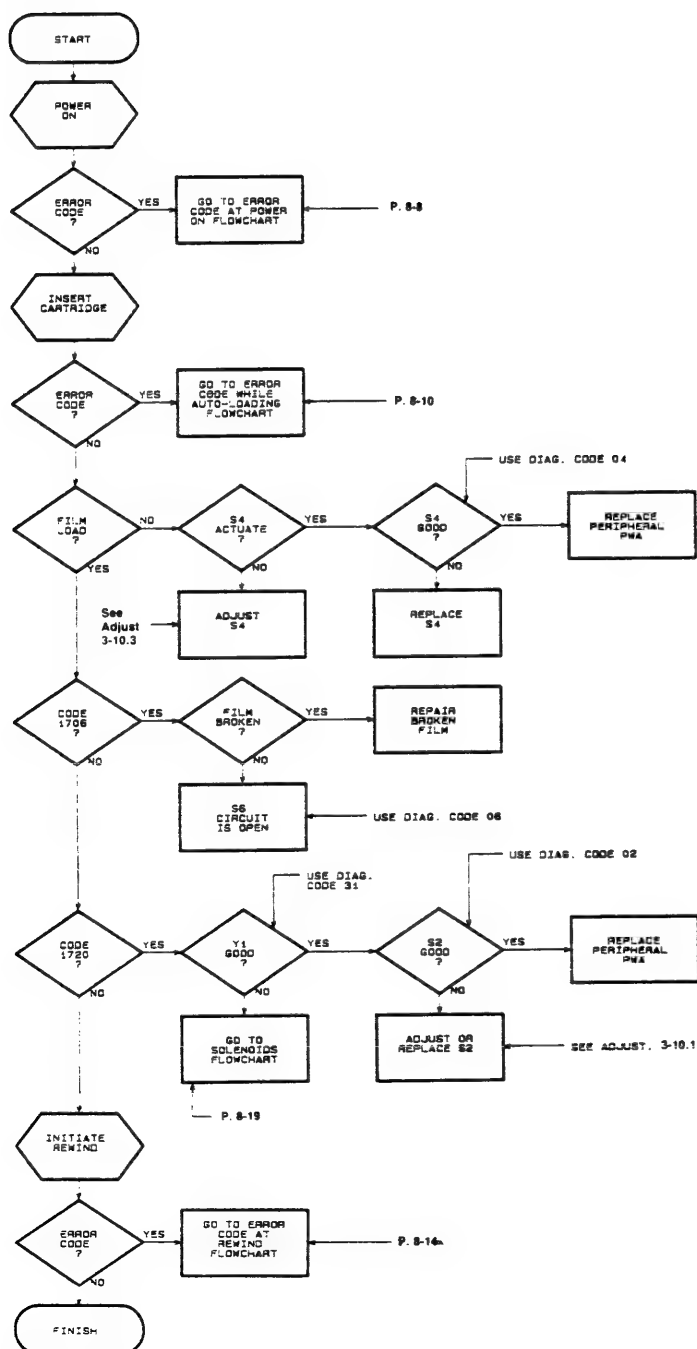
Power problems are virtually the only ones you will encounter that do not trigger Error Codes.

8-3.3. Error Codes

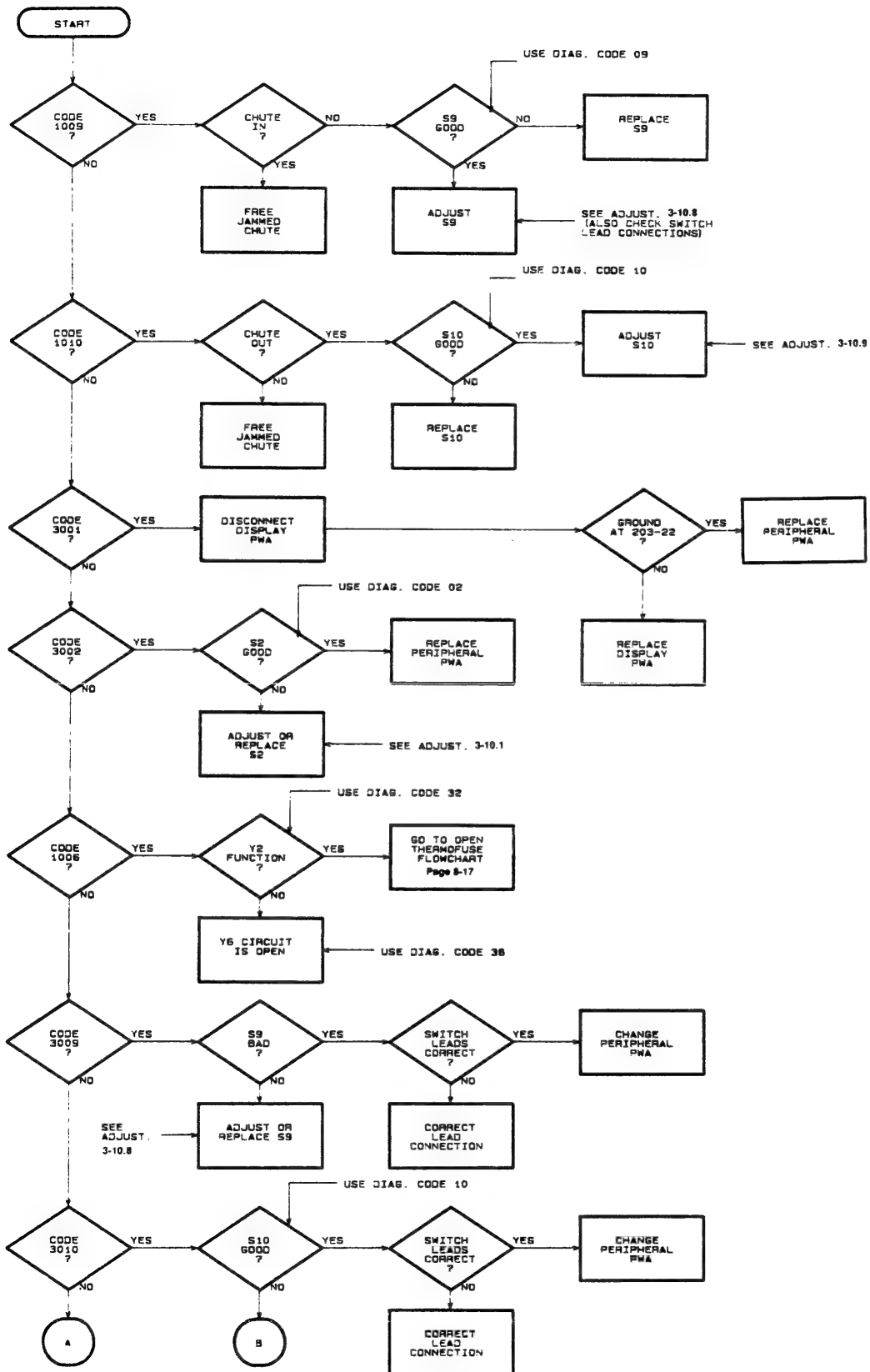
A condition that prevents normal operation of the M-654 will usually result in a single-digit category number shown on the Odometer/Diagnostic--Status Display. Press the Odometer Reset Button when a category number is displayed. A flashing four-digit Error Code will display.

The Error Code Flow charts will aid you in troubleshooting an M-654 problem that results in a flashing Error Code in the Odometer/Error--Status Display. Always start at the beginning of the Overall Error Code Troubleshooting Flowchart and proceed until you reach the flashing Error Code displayed. Then, refer to other flowcharts as directed.

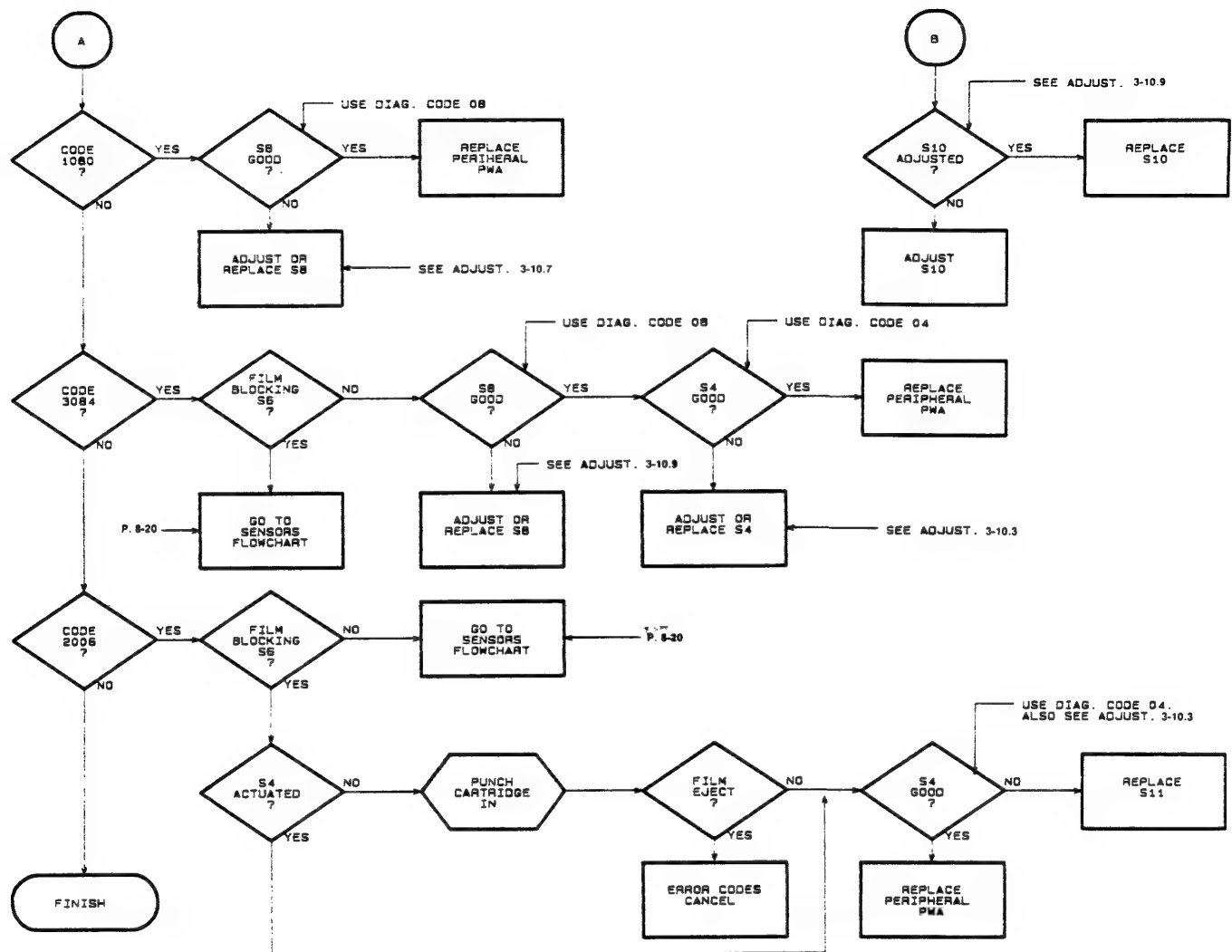
Overall

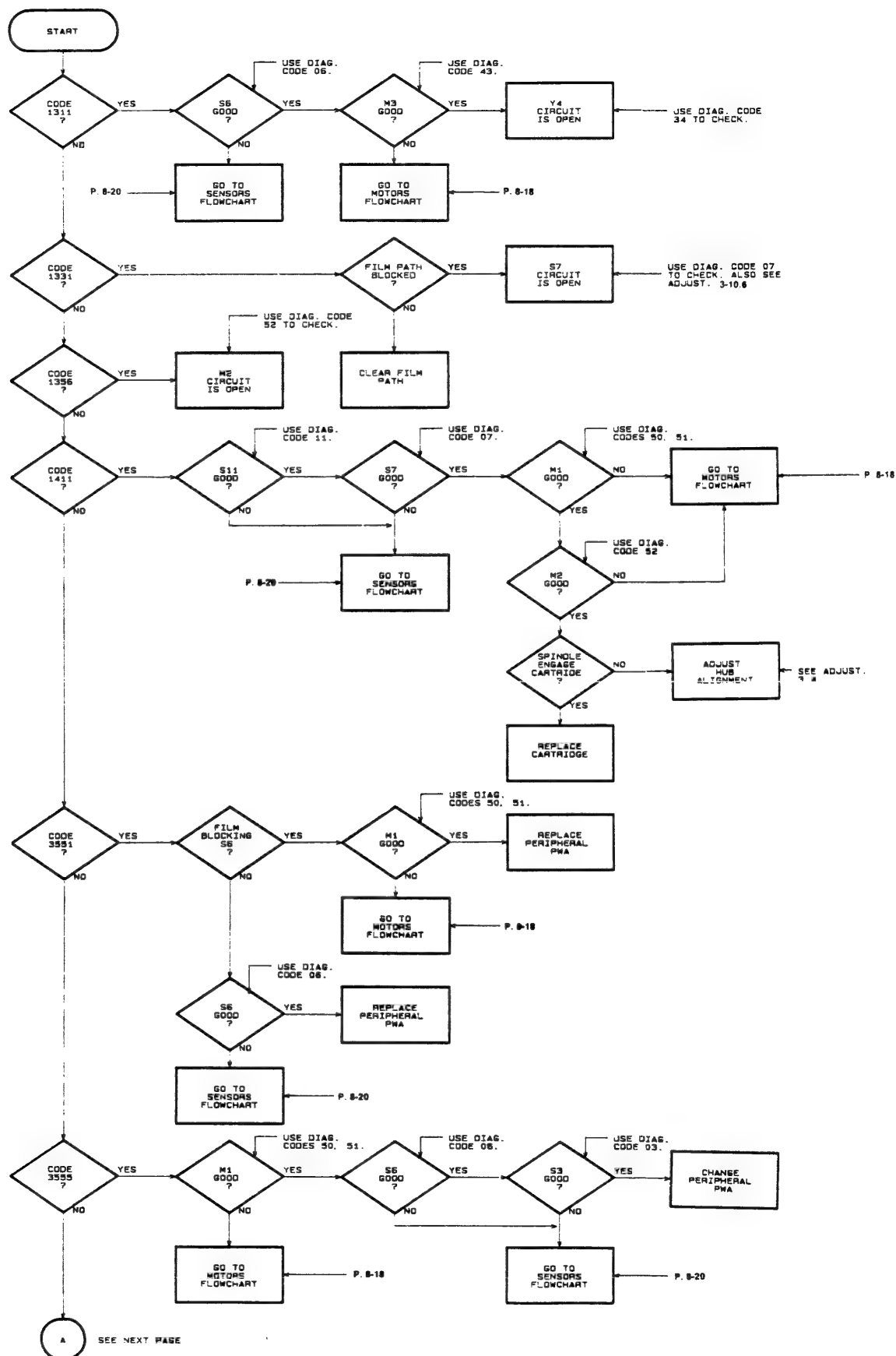


Power ON

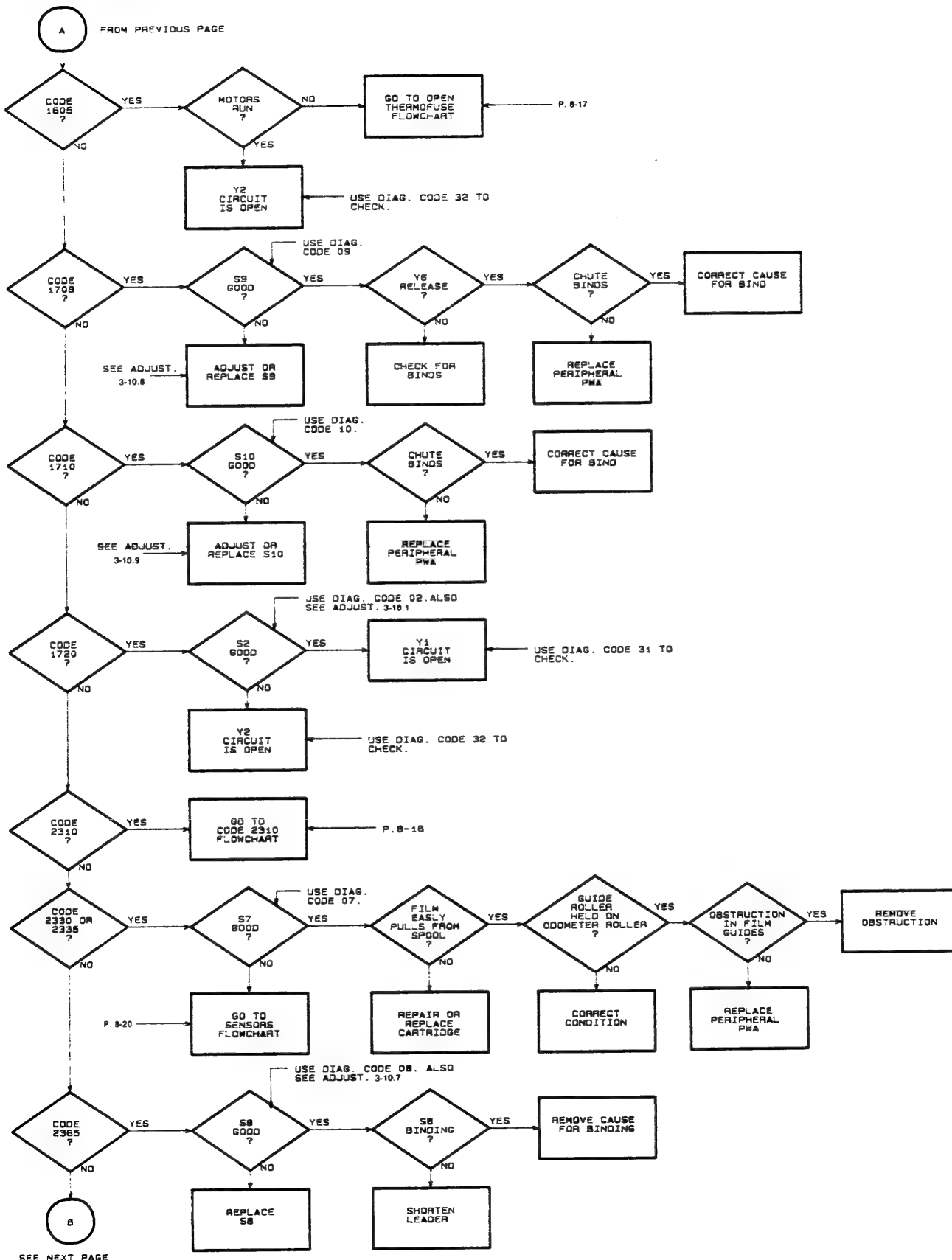


Power ON (Continued)



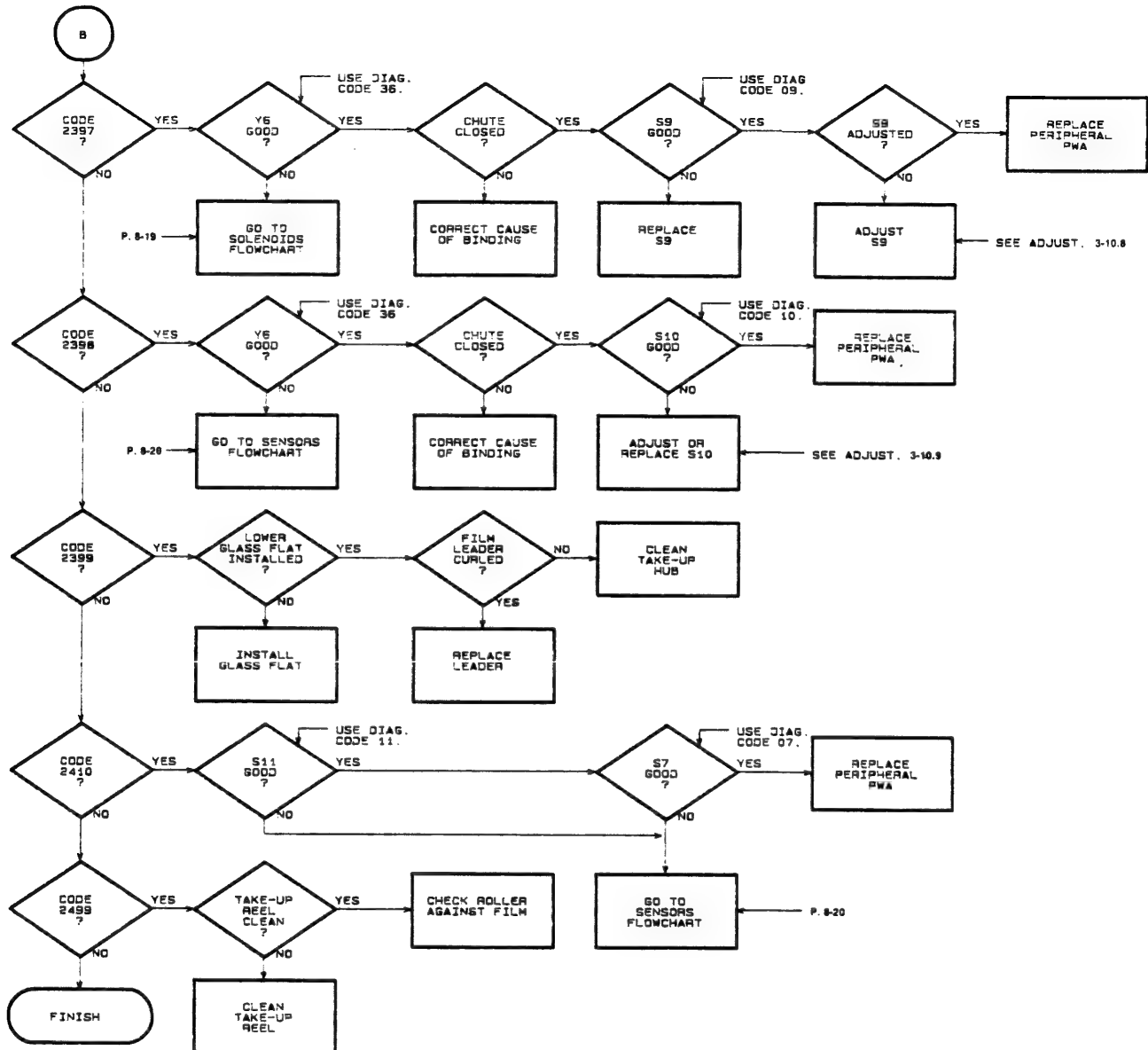


Auto-Load (Continued)

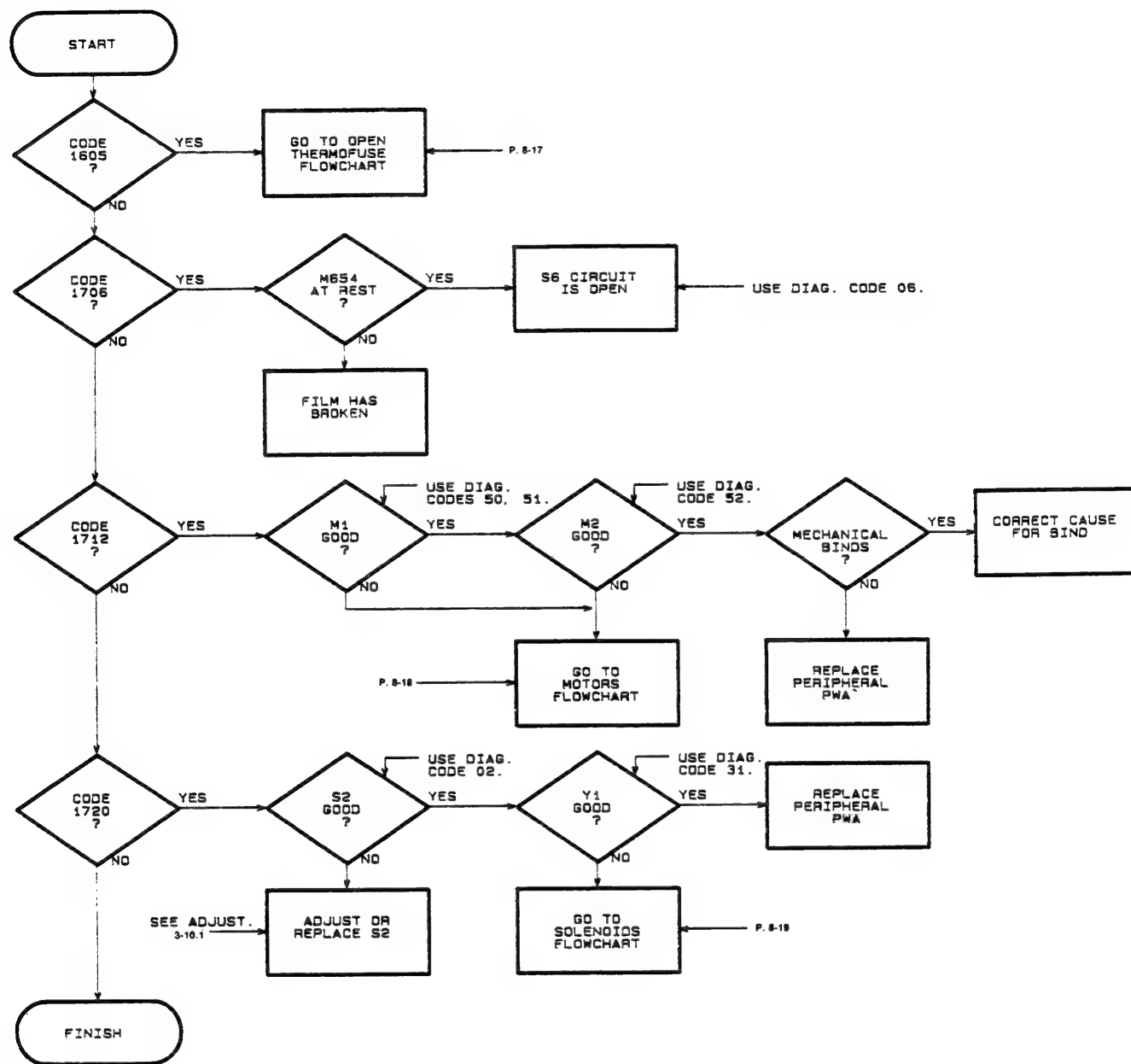


Auto-Load (Continued)

FROM PREVIOUS PAGE



Operation



```

graph TD
    START([START]) --> D1{CODE 3551?}
    D1 -- YES --> D2{S6 GOOD?}
    D1 -- NO --> D3{CODE 3555?}
    D2 -- YES --> P1[M1 CIRCUIT OPEN]
    D2 -- NO --> P2[GO TO SENSORS FLOWCHART]
    P1 --> D3
    P2 --> D3
    D3 -- YES --> D4{M1 GOOD?}
    D3 -- NO --> D5{CODE 1805?}
    D4 -- YES --> P3[S3 CIRCUIT IS OPEN]
    D4 -- NO --> P4[GO TO MOTORS FLOWCHART]
    P3 --> D5
    P4 --> D5
    D5 -- YES --> D6{S4 GOOD?}
    D5 -- NO --> P5[ADJUST OR REPLACE S4]
    D6 -- YES --> P6[Y2 CIRCUIT IS OPEN]
    D6 -- NO --> P5
    P6 --> D7{CODE 1705?}
    P5 --> D7
    D7 -- YES --> D8{FILM BROKEN?}
    D7 -- NO --> D9{CODE APPEARS BEFORE END OF REWIND?}
    D8 -- YES --> P7[REPAIR FILM]
    D8 -- NO --> D9
    D9 -- YES --> P8[S8 CIRCUIT IS OPEN]
    D9 -- NO --> P9[S11 CIRCUIT IS OPEN]
    P7 --> D10{CODE 1718?}
    P8 --> D10
    P9 --> D10
    D10 -- YES --> D11{M1 GOOD?}
    D10 -- NO --> D12{CODE 1721?}
    D11 -- YES --> D13{M2 GOOD?}
    D11 -- NO --> D12
    D12 -- YES --> D14{S2 GOOD?}
    D12 -- NO --> D15{CODE 3550?}
    D14 -- YES --> D16{Y8 RELEASES?}
    D14 -- NO --> P10[ADJUST OR REPLACE S2]
    D16 -- YES --> P11[CHECK GEARS AND DRIVE BELT]
    D16 -- NO --> P12[GO TO MOTORS FLOWCHART]
    P10 --> D15
    P11 --> D15
    P12 --> D15
    D15 -- YES --> P13[GO TO CODE 3550 FLOWCHART]
    D15 -- NO --> A((A))
    A --> D17{CODE 3570?}
    D17 -- YES --> P14[ACTUATE S12]
    D17 -- NO --> D18{CODE 3575?}
    P14 --> D18
    D18 -- YES --> P14
    D18 -- NO --> P15[REFER TO FLOWCHART IN 210 CAT OP. INSTR.]
    P15 --> D17
    D17 --> FINISH([FINISH])
  
```

START

CODE 3551?

YES

S6 GOOD?

YES

M1 CIRCUIT OPEN

USE DIAG. CODE 06.

USE DIAG. CODES 30, 51.

NO

GO TO SENSORS FLOWCHART

P. 8-20

CODE 3555?

YES

M1 GOOD?

YES

S3 CIRCUIT IS OPEN

USE DIAG. CODE 03 TO CHECK.

NO

GO TO MOTORS FLOWCHART

P. 8-18

CODE 1805?

YES

S4 GOOD?

YES

Y2 CIRCUIT IS OPEN

USE DIAG. CODE 04.

NO

ADJUST OR REPLACE S4

SEE ADJUST. 3-10.3

CODE 1705?

YES

FILM BROKEN?

NO

CODE APPEARS BEFORE END OF REWIND?

NO

S11 CIRCUIT IS OPEN

USE DIAG. CODE 11.

YES

REPAIR FILM

YES

S8 CIRCUIT IS OPEN

USE DIAG. CODE 05.

CODE 1718?

YES

M1 GOOD?

YES

M2 GOOD?

YES

S7 CIRCUIT IS OPEN

USE DIAG. CODE 02.

NO

GO TO MOTORS FLOWCHART

P. 8-18

CODE 1721?

YES

S2 GOOD?

YES

Y8 RELEASES?

YES

CHECK GEARS AND DRIVE BELT

NO

ADJUST OR REPLACE S2

SEE ADJUST. 3-10.1

NO

GO TO CODE 3550 FLOWCHART

P. 8-16

CODE 3550?

YES

NO

A

SEE TOP RIGHT THIS PAGE

CODE 3570?

YES

ACTUATE S12

CODE CANCEL?

YES

REFER TO FLOWCHART IN 210 CAT OP. INSTR.

NO

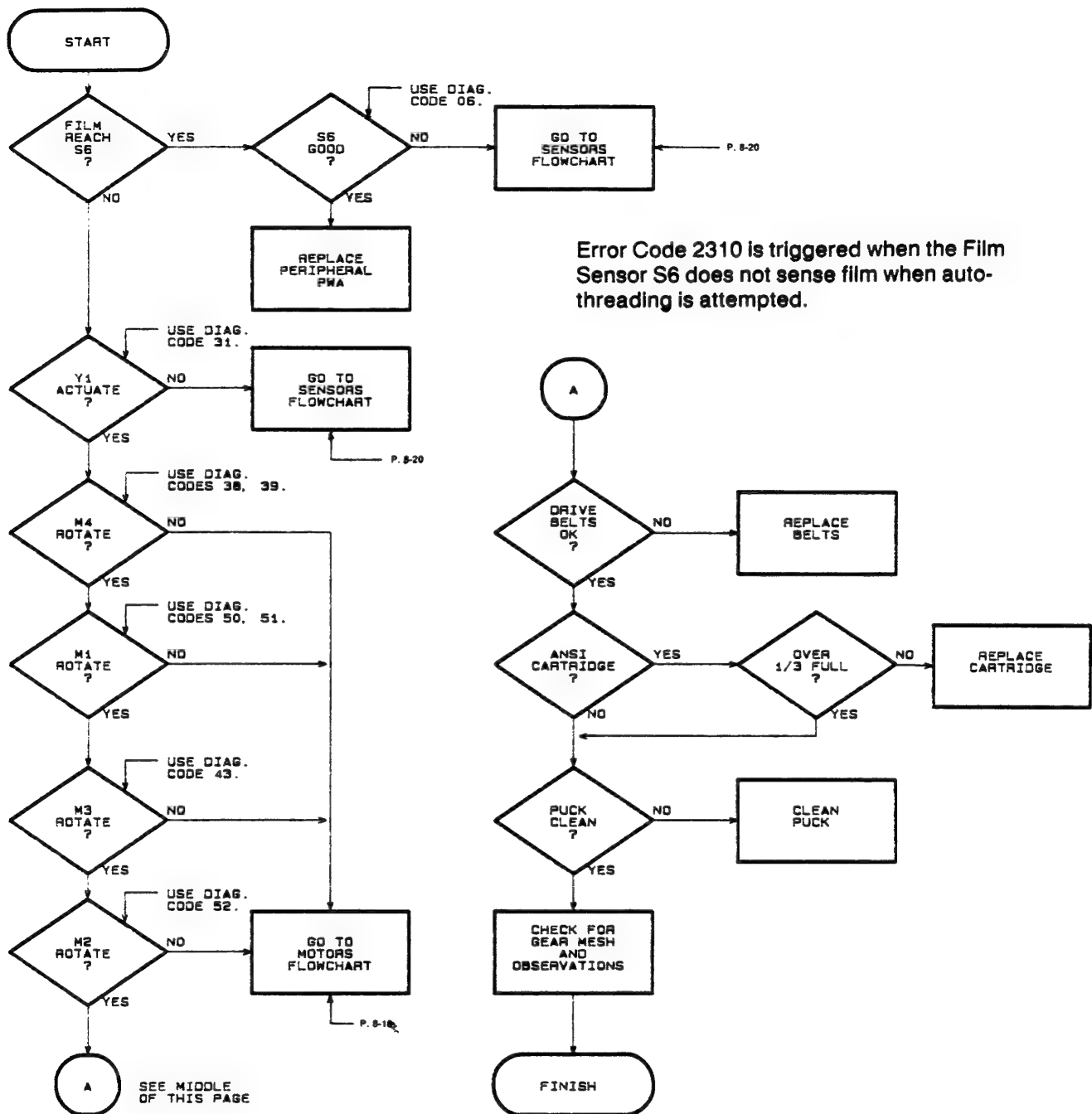
CODE 3575?

YES

NO

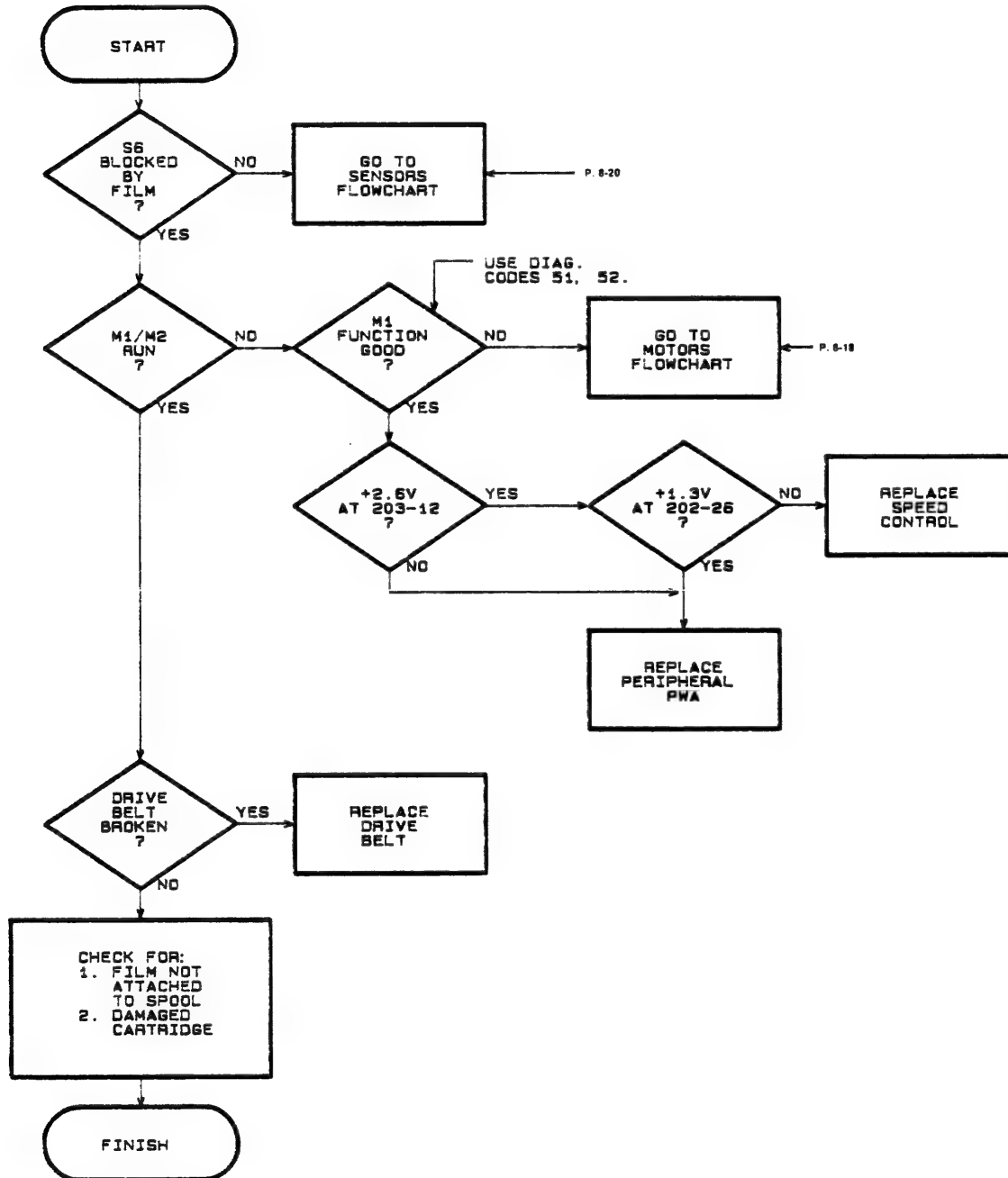
FINISH

2310



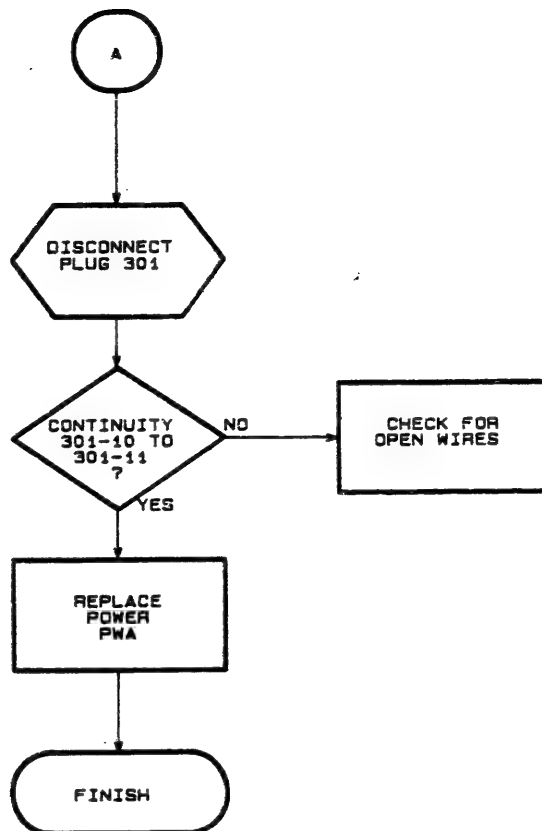
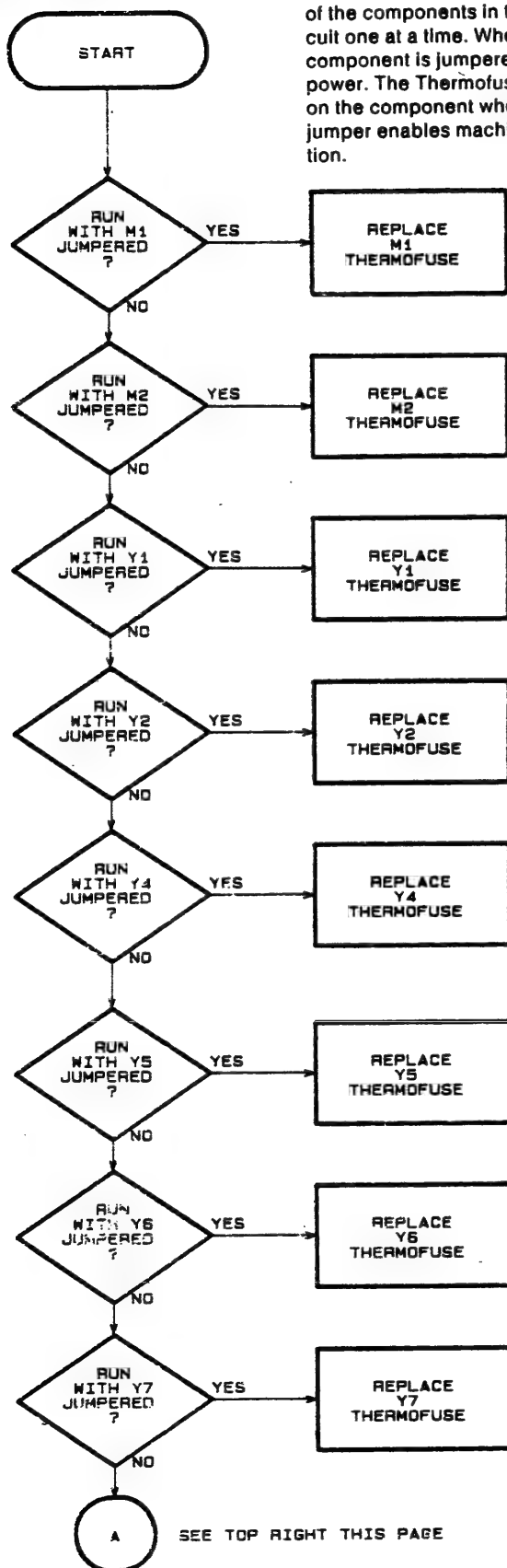
3550

Error Code 2550 is triggered when the Film Sensor S6 does not deactuate within 25 seconds of starting a rewind routine.



Open Thermofuse

Jumper the Thermofuse for each of the components in the circuit one at a time. When a component is jumpered, apply power. The Thermofuse is open on the component where the jumper enables machine operation.



M1 - FILM REVERSE MOTOR

M2 - FILM ADVANCE MOTOR

Y1 - SPINDLE RELEASE SOLENOID

Y2 - EJECT SOLENOID

Y4 - ODOMETER CLUTCH SOLENOID

Y5 - GLASS FLAT SOLENOID

Y6 - CHUTE SOLENOID

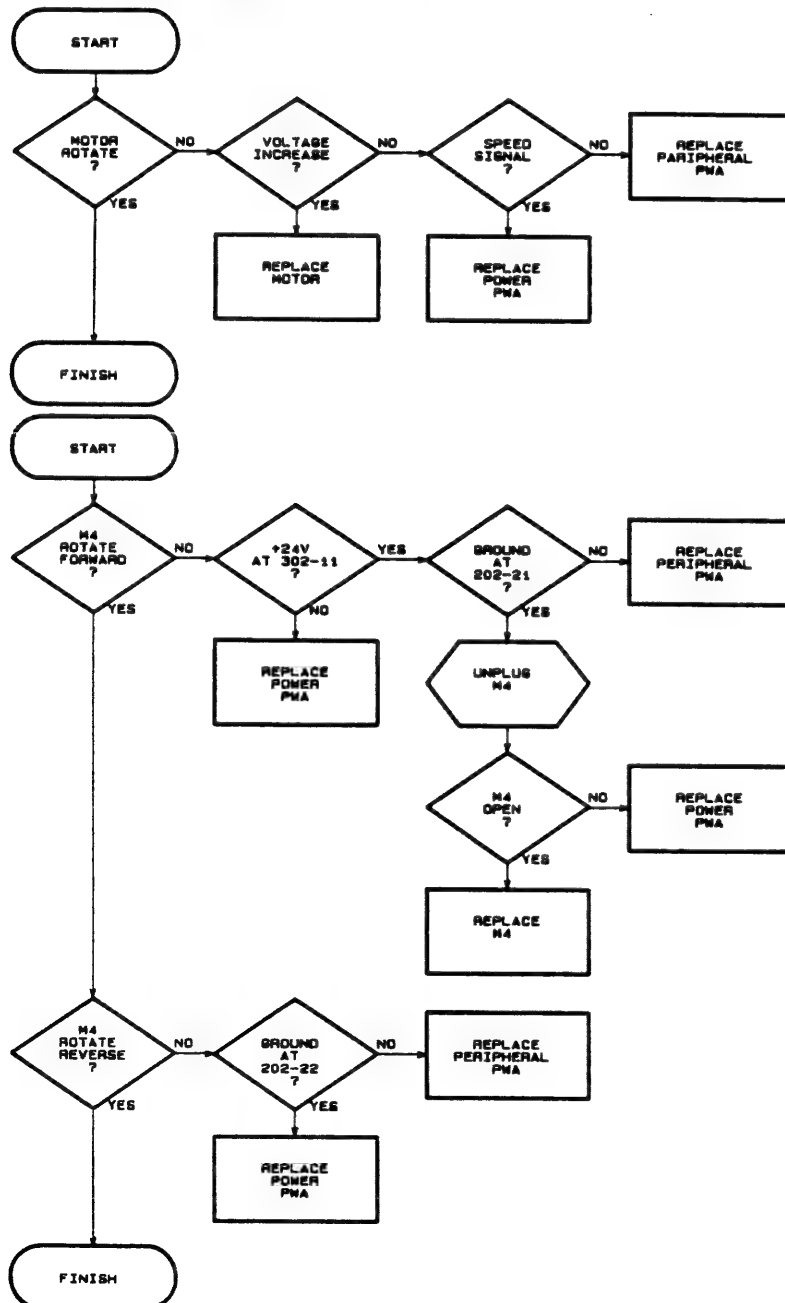
Y7 - BRAKES SOLENOID

8-3.4. Motors

The Film Reverse Motor (M1), Film Advance Motor (M2), and Film Thread Motor (M3) are powered by voltage pulses from the Power PWA. These pulses are difficult to detect with a VOM, and impossible to measure accurately. With the machine in the Diagnostic Mode, any momentary measure on your VOM of a voltage increase to the motor, when the Odometer Reset Button is pressed, is indication that the motor is receiving power.

A Motor Speed Signal from the Peripheral PWA enables M1, M2, or M3. With the machine in the Diagnostic Mode, and the output to the motor at 50%, the Motor Speed Signal, when the Odometer Reset Button is pressed, will be about 1.3 vdc.

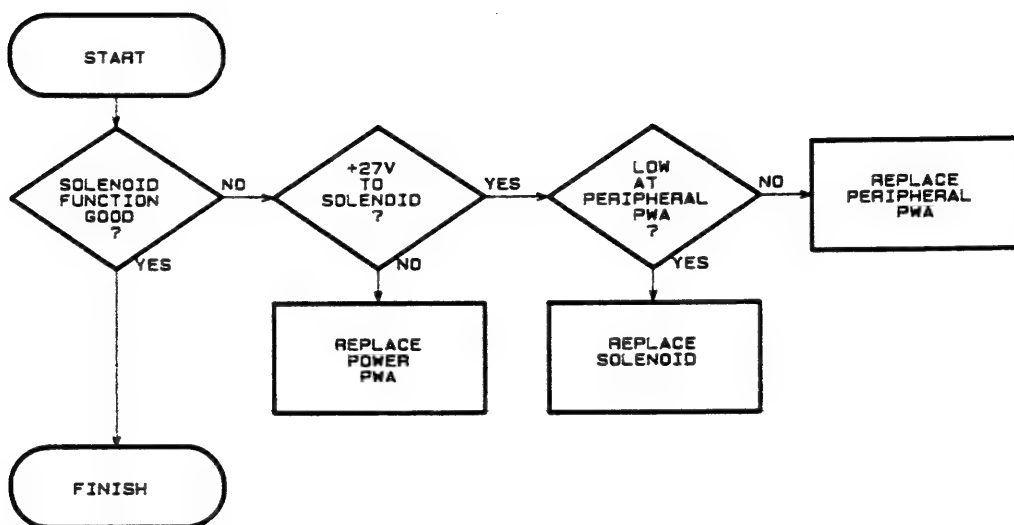
The Swing Motor (M4) is constantly powered. It runs when a Return is provided by the Peripheral PWB. Direction of drive depends on which side of the motor is grounded.



Motor	Voltage Increase	Speed Signal
M1	301-7	301-14
M2	302-9	302-10
M3	302-6	302-7

8-3.5. Solenoids

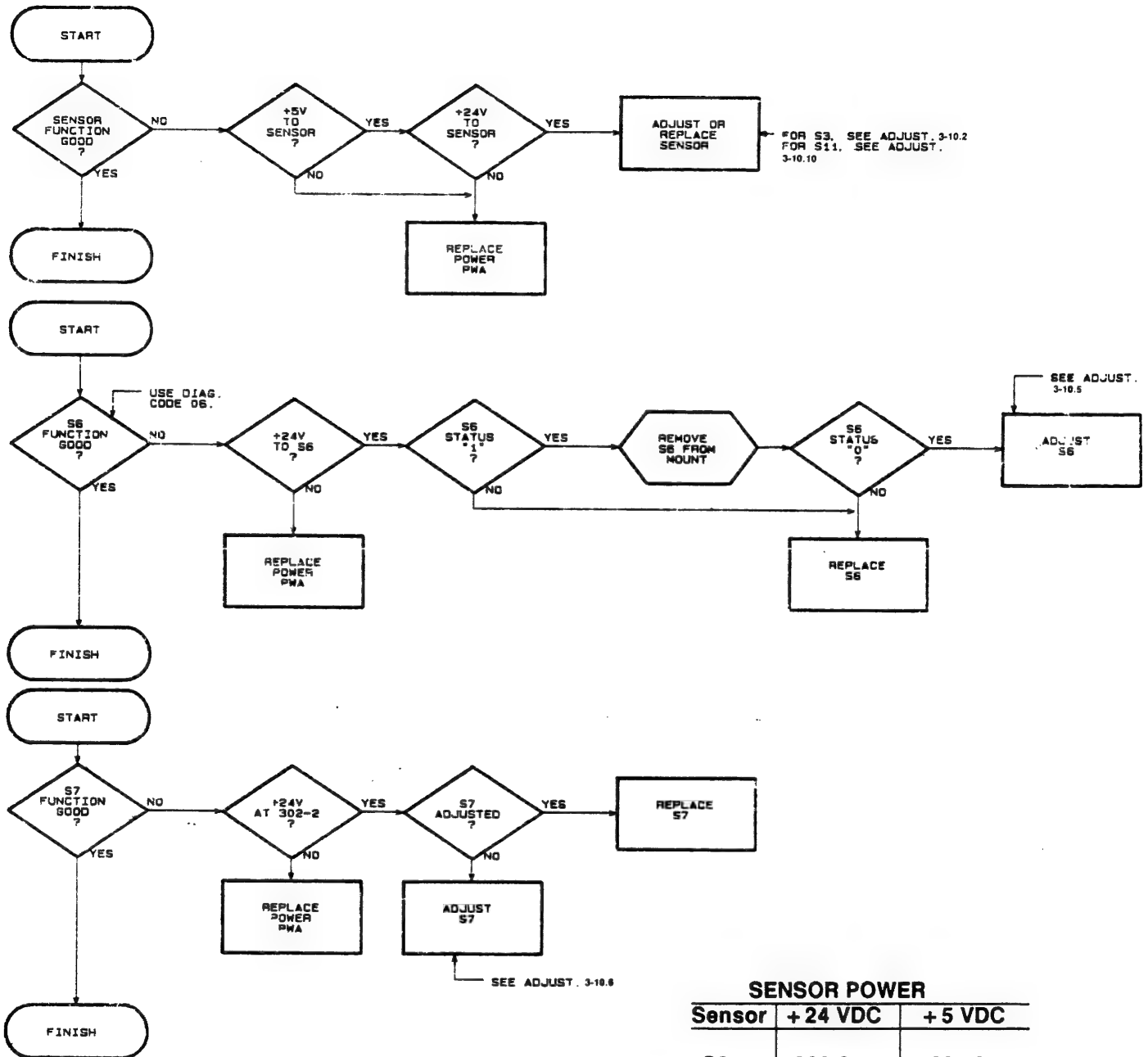
Operating voltage to the solenoids is applied whenever the M-654 is powered. A Return is provided by the Peripheral PWA to actuate a particular solenoid.



SOLENOIDS	POWER (+ 27 VDC)	LOW (+ 12 VDC)
Y1 (Spindle Release)	302-3	202-16
Y2 (Cartridge Eject)	302-3	202-2
Y4 (Odometer Clutch)	302-3	202-17
Y5 (Film Clamp)	302-3	202-18
Y6 (Film Chute)	302-3	202-19
Y7 (Brake)	302-3	202-20

8-3.6. Sensors

Only the Optical Sensors are shown here. Switch functions can be checked using the Diagnostic Codes.



SENSOR POWER		
Sensor	+ 24 VDC	+ 5 VDC
S3	302-2	301-8
S6	302-2	
S7	302-2	
S11	302-2	301-8

8-4. CHECKLIST

The following Checklist is offered as an aid to troubleshooting but should not be considered complete nor does it replace the Troubleshooting Flowcharts. The Checklist is divided into categories to reduce the time to locate a problem. The categories are: General, Power-On, Auto-Thread, Film Scan, Rewind, and Error Codes. Additional pages left blank are for you to complete as you come across problems, causes, and corrections not given.

GENERAL

Problem:	Takes too long to remove covers.
Correction:	1. Use powered screwdriver. 2. Cut Rear Cover in half.
Problem:	Operator gets static shock when machine is touched.
Cause:	Environment.
Correction:	1. Use static mat. 2. Increase room humidity.
Problem:	Machine does not meet full requirements for RFI.
Correction:	Install M-654 RFI Kit (78-8060-7375-1).
Problem:	Power PWA shorts to rear cover.
Correction:	Install rear cover insulation (DZ-6545-0060-9).
Problem:	Scratches on film.
Cause:	Film rubs on edge of Glass Flats.
Correction:	Do Adjustment 3-2. Film Guide Rollers, page 3-1.
Problem:	Film creeps with Film Speed Control set at "0".
Cause:	Brake Disc is misadjusted.
Correction:	Do Adjustment 3-3 Brake Disc, page 3-3.
Problem:	Film Transport doesn't move or moves erratically when Traverse Control is turned.
Cause:	Loose Film Traverse Drive Belt.
Correction:	Do Adjustment 3.11 Film Traverse, page 3-27.

Problem:	Erratic, strange and intermittent electrical problems.
Cause:	1. Older style Anti-static Roller installed. 2. Anti-Static Roller misadjusted.
Correction:	1. Replace existing Anti-static Roller with new roller (DZ-6560-1470-8) 2. Do Adjustment 3-13 Anti-Static Roller, page 3-30.

POWER-ON

Problem:	Machine is totally inoperative.
Cause:	Blown fuse in Reader-Printer 27 VAC line (beneath accessory table).
Correction:	Replace fuse.
Problem:	Film creeps with Film Speed Control set at "0".
Cause:	Brake Disc is misadjusted.
Correction:	Do Adjustment 3-3 Brake Disc, page 3-3.
Problem:	Film Chute Solenoid (Y6) hums.
Cause:	Film Chute Misadjusted.
Correction:	Do Adjustment 3-8 Film Chute IN Gap, page 3-8.

AUTO-THREAD

Problem:	Auto-Thread sequence does not start after cartridge is loaded.
Cause:	Film Start Switch (S4) misadjusted.
Correction:	Do Adjustment 3-10.3 Film Start Switch (S4), page 3-15.

AUTO-THREAD (Cont.)

Problem: 2.5 mil dry Diazo ANSI film wraps around the Puck during auto-thread.

Cause: Film leader too thin.

Correction: Add heavier film leader.

Problem: After two auto-thread attempts, no film is pulled out and the cartridge is ejected.

Cause: Stripper finger is stuck behind film guide and does not allow drive-out roller to contact film.

Correction: Reposition stripper finger. Newer M-654's will have a different design that will not allow this to happen.

Problem: 3M type cartridges occasionally do not load. No film was pulled out of the cartridge during the film loading sequence.

Cause: The leading edge of the film leader is catching on the area shown below.

Correction: Show the operator how to pull out about 8" of leader and put a curl in the leader by pulling the leader between your thumb and a pencil. The curl should be toward the film spool and can be controlled by the amount of pressure applied or the position of your thumb and pencil. Also ensure there are no burrs on the film cartridge.

Problem: The Film Chute pulls in sluggishly if at all during power up or when a cartridge is inserted causing film thread-up problems. The Film Chute should easily pull in at the 5 setting of Diagnostic 36.

Cause: The Film Threading Ball is misadjusted (Adjustment 3-11, Film Threading Ball, page 3-25) or the linkage for the Film Chute Solenoid (Y6) is mispositioned.

Correction: Loosen the screw that attaches the Plunger of the Film Chute Solenoid (Y6) with the linkage to the Film Chute. This will allow the linkage and Plunger to take a position of least resistance. Retighten the screw ensuring that the linkage does not move while tightening. Check that the Film Chute pulls in easily.

Then, Do Film Chute Gap Adjustment 3-7, page 3-7, Film Chute In Switch (S9) Adjustment 3-9.8, page 3-21 and Film Chute Out Switch (S10) Adjustment 3-9.9, page 3-22. Failure to readjust may cause Error Code 1006 during power-up.

AUTO-THREAD (Cont.)

Problem: 3M leader does not exit the cartridge.

Correction:

1. Install optional Stripper Spring (DZ-6565-0460-9) on the Upper Cartridge Guide only on machines at accounts which use 3M cartridges.
2. Do Adjustment 3-16 Stripper Position, page 3-33.
3. Ensure 3M Cartridge Switch (S5) is connected and adjusted correctly.
4. Replace existing Motor Encoder Discs with new discs (DZ-6510-0040-5).

Problem: 3M Leader exits Cartridge but does not reach Odometer Roller.

Cause: Stripper misadjusted.

Correction: Do Adjustment 3-16 Stripper Position, page 3-33.

Problem: 3M leader does not wrap on Take-Up Roller.

Correction: Install M-654 3M Cartridge Thread-Up Kit (78-8060-7355-3) and do Adjustments 3-6 Film Chute Parallelism, page 3-7; 3-7 Film Chute OUT Gap, page 3-7; and 3-8 Film Chute IN Gap, page 3-8.

Problem: Film binds in Film Chute.

Cause: Misadjusted Film Chute Pivot Bracket.

Correction: Do Adjustment 3-17 Film Chute Pivot Bracket, page 3-34.

Problem: Puck wears out prematurely.

Cause: Stripper position misadjusted.

Correction: Do Adjustment 3-16 Stripper Position, page 3-33.

Problem: Thin ANSI film does not thread out properly due to worn Puck.

Correction: Install M-654 Puck Kit (78-8060-7372-8).

Problem: After installing the Manual Eject Kit (IFC 7530-21), nothing happens after the Cartridge is inserted or the Cartridge immediately ejects.

Cause: The Film Jam Switch, S-12, is wired incorrectly.

Correction: Re-wire the Film Jam Switch (S-12). Move the wire from the center Terminal to the bottom Terminal. Prior to installation of this kit, the Switch is normally open. After installation of the new Manual Eject Brackets, the Switch is normally closed.

Problem: Incomplete auto-thread.

Cause:

1. Misadjusted Encoder Disc Roller.
2. Film Chute not parallel.
3. Film Chute IN gap misadjusted.
4. Film Sensor (S6) not adjusted correctly.
5. Misadjusted Odometer Sensor (S7).
6. Film Threading Ball misadjusted.
7. Film Pressure Guide Roller not adjusted correctly.
8. Auxilliary nip pressure improperly adjusted.
9. Incorrect position of Film Chute Pivot Bracket.
10. Misadjusted Film Tread Motor (M3) or broken Drive Belt.

Correction:

1. Do Adjustment 3-5 Encoder Disc Roller, page 3-5.
2. Do Adjustment 3-6 Film Chute Parallelism, page 3-6.
3. Do Adjustment 3-8 Film Chute IN Gap, page 3-8.
4. Do Adjustment 3-10.5 Film Sensor (S6), page 3-17.
5. Do Adjustment 3-10.6 Odometer Sensor (S7), page 3-18.
6. Do Adjustment 3-12 Film Threading Ball, page 3-28.

AUTO-THREAD (Cont.)

7. Do Adjustment 3-14 Film Pressure Guide Roller, page 3-31.
8. Do Adjustment 3-15 Auxilliary Nip Pressure, page 3-32.
9. Do Adjustment 3-17 Film Chute Pivot Bracket, page 3-34.
10. Do Adjustment 3-9.3 Film Thread Motor (M3) Drive Belt or replace Drive Belt (Disassembly 4-4.3, page 4-8).

Problem: Position of splice after auto-thread is incorrect.

Cause:

1. Misadjusted Film Chute.
2. Misadjusted 3M Cartridge Switch (S5).

Correction:

1. Do adjustment 3-7 Film Chute OUT Gap, page 3-7.
2. Do Adjustment 3-10.4 3M Cartridge Switch (S5), page 3-16.

Problem: Film Chute doesn't close after auto-thread.

Cause: Misadjusted Anti-Static Roller.

Correction: Do Adjustment 3-13 Anti-Static Roller, page 3-30.

Problem: Erratic thread-up.

Cause: Misadjusted Stripper.

Correction: Do Adjustment 3-16 Stripper Position, page 3-33.

Problem: ANSI reels weld to carrier and/or wear grooves in carrier.

Correction: Remove existing Eject Springs and install new single Eject Spring (DZ-6565-0420-3).

Problem: Black camera (G01) cartridges weld.

Correction: Replace existing ANSI Hub Pressure Spring with new spring (DZ-6565-0480-7). Adjust Hub Alignment.

Problem: The Set Screw for the Brake Disc continually loosens.

Cause: No Loctite on threads.

Correction: Add Loctite to threads.

Problem: Erratic or no film speed.

Cause:

1. Dirty Odometer Encoder Disc.

2. Loose Film Drive Belt.

3. Broken Film Drive Belt or binding Drive Motor.

Correction:

1. Clean Odometer Encoder Disc.

2. Do Adjustment 3-9 Film Reverse Motor (M1) Drive Belt, page 3-10 and/or 3-10 Film Advance Motor (M2) Drive Belt, page 3-11.

3. Replace Drive Belt (Disassembly 4-4.1 Film Reverse Motor (M1), page 4-7 or 4-4.2 Film Advance Motor (M2), page 4-8).

Problem: End of film is not sensed causing to break or be pulled off film spool.

Cause: Filler used with film.

Correction:

1. Recommend customer not use film having fillers.
2. Have customer remove fillers.
3. Ensure the 3M Cartridge Switch (S5) is connected and adjusted correctly.

FILM SCAN

Problem: Film jitters when film is moving slowly.

Cause: Drive Belts for the Reverse Motor (M1) or Film Advance Motor (M2) are loose.

Correction: Do Adjustments 3-2. Film Guide Rollers, page 3-1, 3-9.1 Film Reverse Motor (M1) Drive Belt, page 3-10 and/or 3-9.2. Film Advance Motor (M2) Drive Belt, page 3-11.

FILM SCAN (Cont.)

- Problem:** A film cartridge loads and the Film Reverse Motor drives but film does not advance.
- Cause:** Broken Lever (Section 2, Item 37).
- Correction:** Install a Metal Lever (Pawl) Kit (78-8060-7335-5).
- Problem:** Film mistracks.
- Correction:**
1. Replace existing Odometer Guide Roller with new roller (DZ-6560-2030-9).
 2. Do Adjustment 3-5 Encoder Disc Roller, page 3-5.
 3. Do Adjustment 3-14 Film Pressure Guide Roller, page 3-31.
 4. Do Adjustment 3-15 Auxillary Nip Pressure, page 3-32.
- Problem:** Film Reverse Motor (M1) or Film Advance Motor (M2) stops.
- Correction:** Replace existing Motor Encoder Discs with new discs (DZ-6510-0040-5).
- Problem:** Film loops.
- Cause:** Film Guide Rollers not adjusted properly.
- Correction:** Do Adjustment 3-2. Film Guide Rollers, page 3-1.
- Problem:** Film reel jams or welds to 3M Cartridge Case.
- Cause:** Cartridge Drive Hub not adjusted properly.
- Correction:** Do Adjustment 3-4 Cartridge Drive Hub, page 3-4.
- Problem:** Hub does not drive reel (Drive Pins not engaged).
- Cause:** Cartridge Drive Hub misadjusted.
- Correction:** Do Adjustment 3-4 Cartridge Drive Hub, page 3-4.

- Problem:** Odd scan problems.
- Cause:**
1. Anti-Static Roller misadjusted.
 2. Early roller installed.
- Correction:**
1. Do Adjustment 3-13 Anti-Static Roller, page 3-30.
 2. Install new Anti-Static Roller (DZ- 6560-1470-8).

REWIND

- Problem:** Film does not slow down before reaching end of roll/and may pull off of reel.
- Correction:**
1. Ensure the two wires to 3M Cartridge Switch (S5) are on the rear two terminals.
 2. Replace existing Motor Encoder Discs with new discs (DZ-6510-0040-5).
 3. Do Adjustment 3-10.10 Advance Motor Speed Sensor (S11), page 3-25.
- Problem:** Slow rewinds.
- Correction:** Replace existing Motor Encoder Discs with new discs (DZ-6510-0040-5).
- Problem:** Cartridge eject problems.
- Correction:**
1. Install Cartridge Locator Ring (DZ-6560-1480-7).
 2. Replace existing Spindle Release Solenoid with new solenoid (DZ-6515-0220-2).
 3. Do Adjustment 3-10.1 Spindle Position Switch (S2), page 3-13.
- Problem:** Incorrect end-of-film sensing and early Cartridge eject.
- Cause:** Some replacement Motor Speed Sensors DZ-6515-0110-5 have a white, sticky substance on them. This substance reduces the Sensor's ability to sense Encoder Disk rotation.
- Correction:** Remove this substance from new Motor Speed Sensors.

REWIND (Cont.)

Problem: The film cartridge will not eject from the M-654 after removing and reinstalling the Ejector Assembly (IPB Section 2, Item 59).

Cause: Improper reassembly. The right tab of the Ejector Assembly must be positioned between the Spring Clip (Item 46) and the Film Start Switch Actuator (Item 47B).

Correction: Disassemble and reinstall correctly.

Problem: Film does not rewind although Film Reverse Motor (M1) drives. ERROR 3550.

Cause: Drive Pins of Cartridge Drive Hub do not engage film cartridge, causing film not to rewind.

Correction: Do Adjustment 3-4. Cartridge Drive Hub, page 3-4.

Problem: Film pulls out of cartridge at film end.

Cause: Reverse Motor Speed Sensor misadjusted.

Correction: Do Adjustment 3-10.2 Reverse Motor Speed Sensor (S3), page 3-14.

1002 ERROR CODE

Problem: Frequent Error Code 1002 on M-654 and Error Code 29 on M-656 (if installed).

Cause: The M-654 Anti-Static Roller does not apply a continuous ground during film movement. Resistance from the roller to the chassis should be zero but is intermittent as the roller moves on the shaft. The roller will also bounce as film passes. As the roller floats above ground, sometimes during the bouncing, a voltage spike is generated on the 5 volt line and the M-654 software is "lost".

The 1002 Error Code is a reset code for lost software and the M-654 will operate normally after it is cleared. However, this "reset" signal is also sent to the M-656 and thus error 29 or some other related Error Code will occur.

Correction:

1. Do Adjustment 3-13 Anti-Static Roller, page 3-30.
2. Replace existing Anti-Static Roller with new roller (DZ-6560-1470-8).

Problem: Spindle Release Solenoid de-energizes early. Film jitters when stopped for viewing.

Correction: Install latest revision of D110 EPROM (DZ-6520-0170-9).

1006 ERROR CODE

Cause:

1. Film Chute is not parallel.
2. Film Chute In Switch (S9) does not actuate during power-up.
3. A Thermofuse is open.

Correction:

1. Do Adjustment 3-6 Film Chute Parallelism, page 3-6.
2. Do Adjustment 3-8 Film Chute IN Gap, page 3-8.
3. Check all solenoids diagnostically.

1311 ERROR CODE

Problem: Film will attempt to auto-thread, then eject.

Cause: Film Sensor (S6) is not sensing film.

Correction:

1. Check Film Sensor (S6) diagnostically. Clean or adjust.
2. Check 24 vdc to Film Sensor (S6).
3. Do Adjustment 3-10.5. Film Sensor (S6), page 3-17.

1331 ERROR CODE

Problem: Film attempts to auto-thread, then ejects.

Cause: Minimum film length was not sensed.

Correction:

1. Check Odometer Sensor (S7) diagnostically.
2. Check 24 vdc to Odometer Sensor (S7).
3. Do Adjustment 3-10.6 Odometer Sensor, page 3-18.

- c. Check Power PWA 27 vdc voltage.
2. Recommend customer to not use these brands.
3. Do Adjustment 3-10.6 Odometer Sensor (S7), page 3-18.

1605 ERROR CODE

Problem: When Film Cartridge is inserted, motors do not run.

Cause: Thermofuse open.

Correction: Check/replace Thermofuse.

1712 ERROR CODE

Cause:

1. ANSI or 3M Film Cartridge welded to the carrier. The reel rubs the lower part of the carrier because the Ejector Assembly (Section 2, Item 59) pushes the carrier into the reel. The friction causes the reel to bind or rub a groove into the carrier eventually causing the motors to stall.
2. Hub of Zeta Brand or Blank Brand film cartridge used is too large.
3. Misadjusted Odometer Sensor (S7).

Correction:

1. a. For ANSI: Remove the lower Tension Spring (Section 2, Item 61) and install it beside the upper Tension Spring. Both springs are still needed to eject a cartridge.
- b. For 3M: Do Adjustment 3-4 Cartridge Drive Hub.

1720 ERROR CODE

Cause: Solenoid drops out because of insufficient voltage.

Correction: Check voltage at source.

3550 ERROR CODE

Cause: Drive Pins of Cartridge Drive Hub do not engage film cartridge, causing film not to rewind.

Correction: Do Adjustment 3-4. Cartridge Drive Hub, page 3-4.

X002 ERROR CODE

Cause: Spindle Position Switch (S2) misadjusted.

Correction: Do Adjustment 3-10.1 Spindle Position Switch (S2), page 3-13.

X006 ERROR CODE

Cause:

1. Film Start Switch (S4) misadjusted.
2. Film Sensor (S6) misadjusted.
3. Film Chute IN Switch (S9) misadjusted.
4. Film Chute OUT Switch (S10) misadjusted.

Correction:

1. Do Adjustment 3-10.3 Film Start Switch (S4), page 3-15.
2. Do Adjustment 3-10.5 Film Sensor (S6), page 3-17.
3. Do Adjustment 3-10.8 Film Chute In Switch (S9), page 3-23.
4. Do Adjustment 3-10.9 Film Chute OUT Switch (S10), page 3-24.

X009 ERROR CODE

Cause: Film Chute IN Switch (S9) misadjusted.
Correction: Do Adjustment 3-10.8 Film Chute In Switch (S9), page 3-23.

X010 ERROR CODE

Cause: Film Chute OUT Switch (S10) misadjusted.
Correction: Do Adjustment 3-10.9 Film Chute OUT Switch (S10), page 3-24.

X080 ERROR CODE

Cause: 1. Film Start Switch (S4) misadjusted.
 2. Leader Sense Switch (S8) misadjusted.
Correction: 1. Do Adjustment 3-10.3 Film Start Switch (S4), page 3-15.
 2. Do Adjustment 3-10.7 Leader Sense Switch (S8), page 3-22.

X084 ERROR CODE

Cause: Film Sensor (S6) misadjusted.
Correction: Do Adjustment 3-10.5 Film Sensor (S6), page 3-17.

X310 ERROR CODE

Cause: 1. Film Start Switch (S4) misadjusted.
 2. Film Sensor (S6) misadjusted.
 3. Stripper Position misadjusted.
Correction: 1. Do Adjustment 3-10.3 Film Start Switch (S4), page 3-15.
 2. Do Adjustment 3-10.5 Film Sensor (S6), page 3-17.
 3. Do Adjustment 3-16 Stripper Position, page 3-33.

X311 ERROR CODE

Cause: Stripper Position misadjusted.
Correction: Do Adjustment 3-16 Stripper Position, page 3-33.

X330 ERROR CODE

Cause: Film Start Switch (S4) misadjusted.
Correction: Do Adjustment 3-10.3 Film Start Switch (S4), page 3-15.

X331 ERROR CODE

Cause: Stripper Position misadjusted.
Correction: Do Adjustment 3-16 Stripper Position, page 3-33.

X335 ERROR CODE

Cause: Film Start Switch (S4) misadjusted.
Correction: Do Adjustment 3-10.3 Film Start Switch (S4), page 3-15.

X397 ERROR CODE

Cause: Film Chute IN Switch (S9) misadjusted.
Correction: Do Adjustment 3-10.8 Film Chute In Switch (S9), page 3-23.

X398 ERROR CODE

Cause: Film Chute OUT Switch (S10) misadjusted.
Correction: Do Adjustment 3-10.9 Film Chute OUT Switch (S10), page 3-24.

X410 ERROR CODE

Cause: Film Start Switch (S4) misadjusted.
Correction: Do Adjustment 3-10.3 Film Start Switch (S4), page 3-15.

X411 ERROR CODE

Cause: Film Start Switch (S4)
misadjusted.
Correction: Do Adjustment 3-10.3 Film
Start Switch (S4), page 3-15.

X550 ERROR CODE

Cause: Film Sensor (S6) misadjusted.
Correction: Do Adjustment 3-10.5 Film
Sensor (S6), page 3-17.

X575 ERROR CODE

Cause: Spindle Position Switch (S2)
misadjusted.
Correction: Do Adjustment 3-10.1 Spindle
Position Switch (S2), page
3-13.

X706 ERROR CODE

Cause: Film Sensor (S6) misadjusted.
Correction: Do Adjustment 3-10.5 Film
Sensor (S6), page 3-17.

X709 ERROR CODE

Cause: Film Chute IN Switch (S9)
misadjusted.
Correction: Do Adjustment 3-10.8 Film
Chute In Switch (S9), page
3-23.

X710 ERROR CODE

Cause: Film Chute OUT Switch (S10)
misadjusted.
Correction: Do Adjustment 3-10.9 Film
Chute OUT Switch (S10), page
3-24.

X720 ERROR CODE

Cause: Spindle Position Switch (S2)
misadjusted.
Correction: Do Adjustment 3-10.1 Spindle
Position Switch (S2), page
3-13.

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

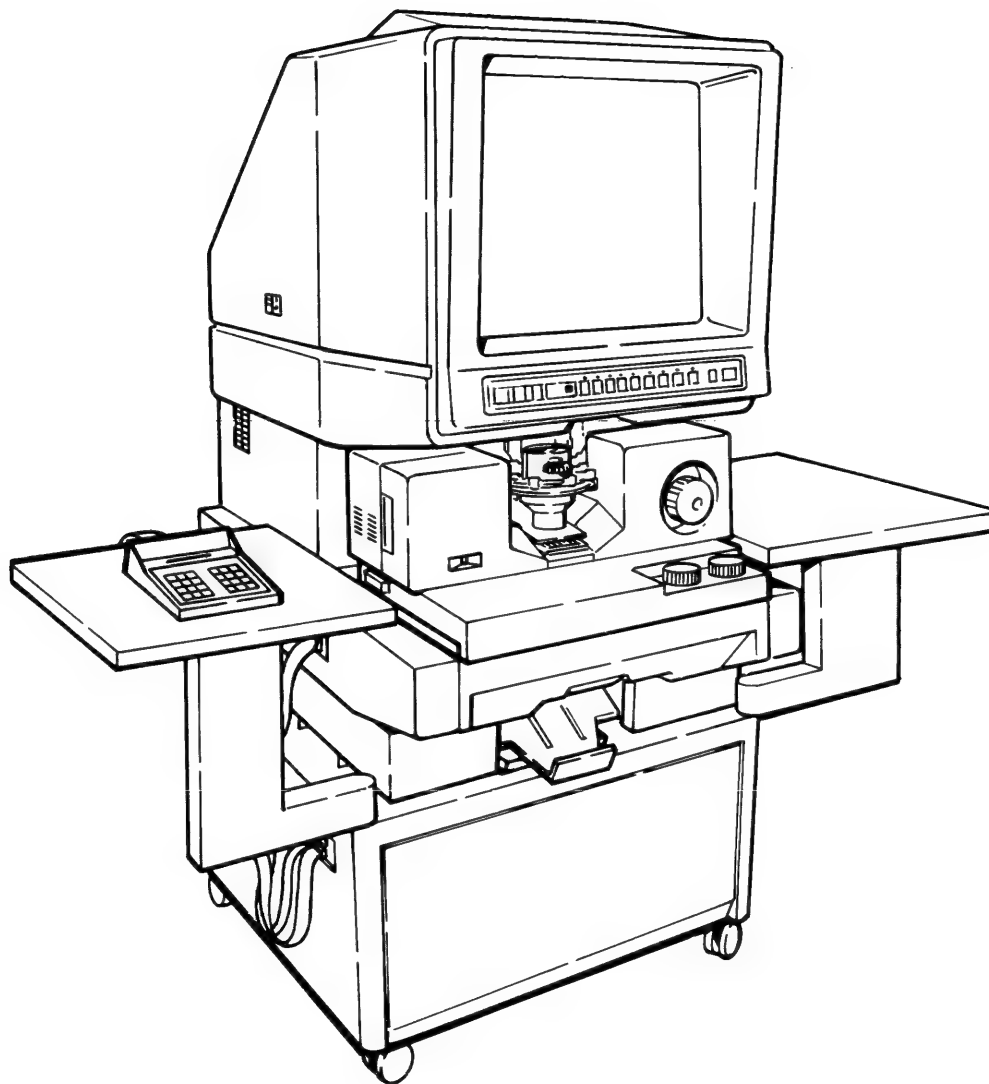
Problem: _____

Cause: _____

Correction: _____

Field Service Handbook

M656 Page Search



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* Located in the binder pocket

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1-1. DESCRIPTION

The 3M Model 656 Page Search is a 3M Qualified Technician installed option for the 3M Model 7530 "1100 MFB" Reader-Printer or Model 7540 MFB Reader-Printer and Model 654 "210 CAT" Cartridge ANSI Transport.

1-2. APPLICATION

The M-656 is typically installed where users desire sophisticated document retrieval by blip-sensing page search.

1-3. MACHINE SPECIFICATIONS**Shipping Dimensions**

Height: 15-1/2 in. (39.37 cm)

Depth: 30-1/2 in. (77.47 cm)

Width: 19-3/4 in. (50.17 cm)

Shipping Weight

45 lb (99.20 kg)

Module Dimensions

Height: 11-1/2 in. (29.21 cm)

Depth: 25-7/8 in. (65.72 cm)

Width: 15 in (38.10 cm)

Machine Weight

37 lb (16.79 kg)

Power Requirements

Voltage: 115 VAC/190 - 270 VAC

Current: 1 A

Frequency: 50/60 Hz

Power Consumption

150 Watts average

Noise Level

42 dbA maximum

Operating Environment

10° C to 30° C (50° F to 86° F)

20% to 80% RH

1-4. OPTIONS**API (Asynchronous Protocol Interface Communications)**

Communications Line Type
EIA RS232C Specification

External Connector Type
RS232C Type D, 25-Pin

Transmission Rate
50 to 19,000 Baud

Character Code Set ASCII

Operating Modes

3M Direct Search (Micrapoint)

3M Download

3M Enhanced Download

CAR (Computer Assisted Retrieval)

BPI (Bi-phase Protocol Interface Communications)

Communications Line Type
Coax Type RG62AU

External Connector Type
Coax Type BNC for Signals RS232C,
Type D, 25-Pin for Printer

Transmission Rate
2.3587 megabits per second

Character Code Set
Bi-phase Manchester II Encoding

Operating Modes

3M Download

CAR (Computer Aided Retrieval)

* All values are approximate

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2-1. GENERAL

The M-656 "Page Search" requires an M-7530 "MFB 1100" or M-7540 MFB Reader-Printer, M-654 "210 CAT" Cartridge ANSI Transport, Workstation and Workstation Arms (each item ordered separately). Refer to the Installation Instructions for the reader-printer and film transport and install these machines and the workstation first if not already done. Ensure these machines are working properly before installing the M-656.

Review the Training Material and read the Operating Instructions, Field Service File, and Installation Instructions completely before setting up the M-656 "Page Search".

CAUTION

Several kits must be installed or modifications made to the M-654 and M-7530 for the M-656 to operate. Review Section 2-3.2. Cartridge ANSI Transport and 2-3.3. Reader-Printer. Complete these additional instructions as required.

This installation is very M-654 and M-7530/7540 Serial Number sensitive. Be sure S/N effectivity instructions are followed.

2-2. UNPACKING

1. Inspect the Shipping Carton for damage that could indicate damage to the machine.
2. Open the Shipping Carton and remove all taped down components.
3. Lift out the Page Search Module.
4. Inspect and report any damage or missing parts on the Product Registration Report and return it to:

Quality Assurance
Office Systems Division/3M
235-3D-28, 3M Center
St. Paul, MN 55101-9924

2-3. SET-UP

CAUTION

The Set-Up Procedures must be performed only by a 3M Qualified Service Representative.

Note

Refer to the figure on page 2-ii for overall assembly.

2-3.1. Workstation

1. Remove the entire contents from the Shipping Packages and check each item against the M-656 Installation Loose Parts Check List, page 2-i.

Note

Do Step 2 only if the M-656 is to receive power from 190 VAC to 270 VAC. Otherwise, go on to Step 3.

2. If the Page Search is to receive power from a 190 VAC to 270 VAC power outlet, cut the Jumper on the Page Search Power Supply PWB (Figure 2-3.1A) marked "Cut for 230 V".

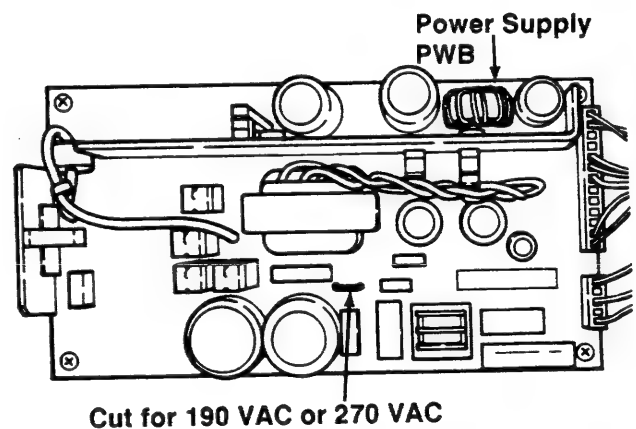


Figure 2-3.1A

3. Open the Front Door of the Workstation (Press in upper left corner and release).
4. Remove and discard eight plastic Fasteners and three Covers from the Workstation (Figure 2-3.1B).

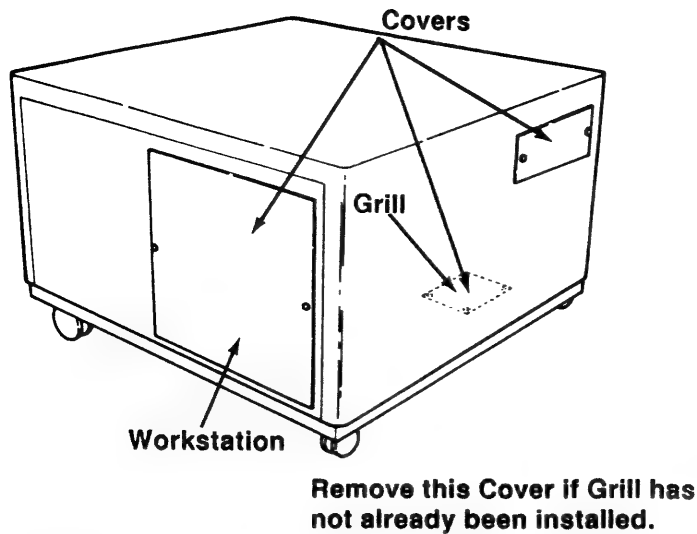


Figure 2-3.1B

Note

Do Step 6 only if the Grill (Figure 2-3.1C) has not already been installed in the Workstation. Otherwise, go to Step 6.

5. Secure the Grill (Item 3) on the base inside the Workstation with four 8-32 x 1/2 in. Pan Head Machine Screws (Item 4) and four 8-32 Keps Nuts (Item 5). The screw heads and Grill should be inside the Workstation with the nuts on the outside (Figure 2-3.1C).

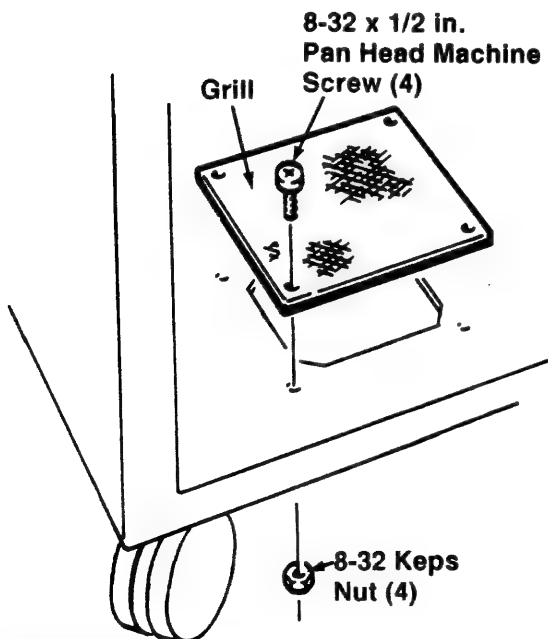


Figure 2-3.1C

6. Position the Page Search Module (Item 1), within the Workstation to the right side.
7. Feed the Cable Harnesses through the port on the left side of the Workstation (Figure 2-3.1D).

8-32 x 1/2 in.
Pan Head Taptite
Screw (2)

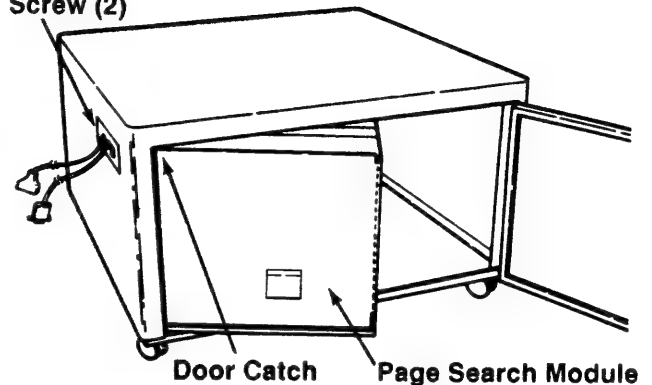


Figure 2-3.1D

8. Move the front end of the Page Search Module all the way to the left first placing the Left Frame behind the Door Catch (Figure 2-3.1D) then push the rear to the left.

Note

The screws loosely installed in steps 9 and 10 will be tightened later.

9. Loosely install two 8-32 x 1/2 in. Pan Head Taptite Screws (Item 2) through the left side of the Workstation into the Page Search Module (Figure 2-3.1D).
10. Loosely install two 8-32 x 1/2 in. Pan Head Taptite Screws (Item 2) at the rear of the Workstation (Figure 2-3.1E).
11. Position the Keyboard (Item 6) on either the Right or Left Workstation Arm and route the Keyboard Harness between the M-7530/7540 and Workstation to the rear.
12. Remove the protective liner from both Cable Clamps (Item 28) and adhere them to the right and left sides of the Workstation about 3/4 distance from the front and 3/4 distance from the bottom.
13. Install the Keyboard Harness within one of the Cable Clamps installed in step 12 to prevent the harness from touching the floor.

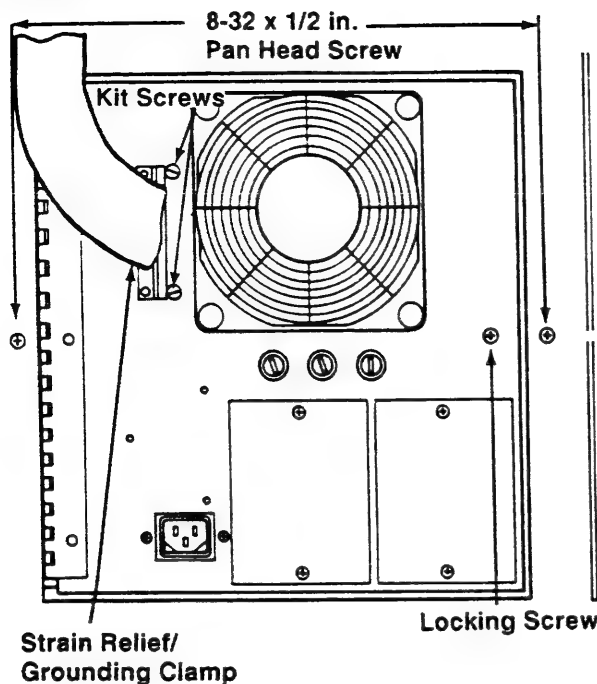


Figure 2-3.1E

14. Remove the Locking Screw securing the Rear Door of the Workstation and open the Rear Door (Figure 2-3.1E).
15. With the red edge of the keyboard cable up, feed the Edgcard Connector and harness through the slot in the Rear Door (Figure 2-3.1E).
16. Install the threaded half of the Strain Relief/Grounding Clamp (Item 26) on the inside of the Rear Door (Figure 2-3.1E) with the Kit Screws (Figure 2-3.1F).
17. Install the non-threaded half of the Strain Relief/Grounding Clamp on the threaded half installed in Step 14 using the Kit Screws (Figure 2-3.1F).
18. Position the exposed Copper Shield of the harness within the Strain Relief/Grounding Cable Clamp and tighten the screws (Figure 2-3.1F) installed in Step 15.
19. With the red edge of the cable up plug the Keyboard Harness Edgcard Connector into the left edge of the Logic Back Plane PWB (Figure 2-3.1F)
20. Install the Keyboard Harness in the Cable Clamp mounted on the right side of the Page Search Module (Figure 2-3.1F).

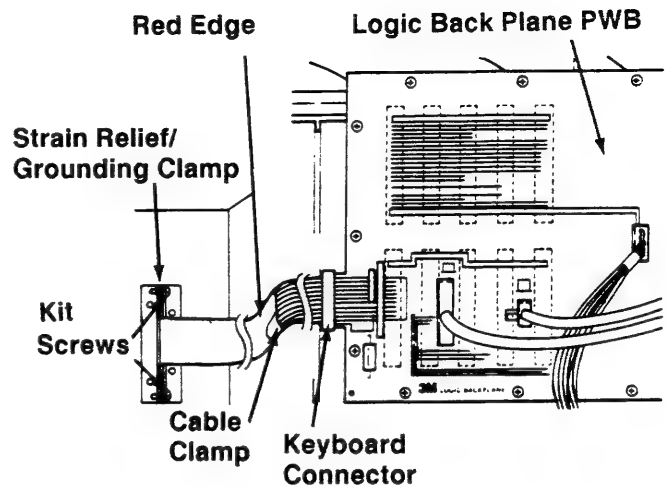


Figure 2-3.1F

21. Remove the Locking Screw securing the Card Cage Door (Figure 2-3.1G) and open the door.

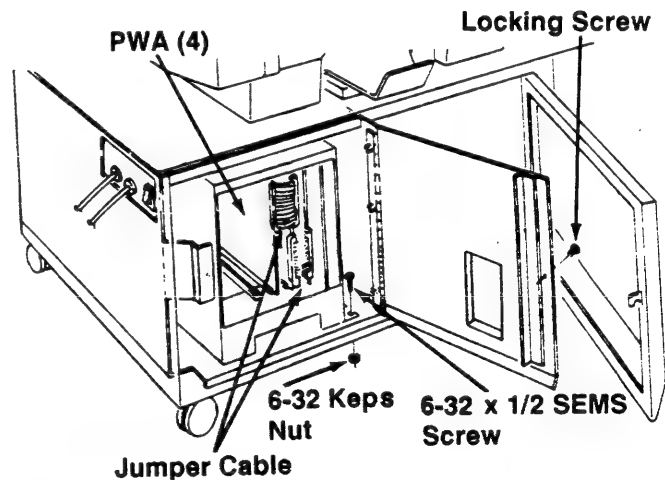


Figure 2-3.1G

22. Install a 6-32 x 1/2 in. Screw (Item 24) and 6-32 Keps Nut (Item 25) on the right side of the Page Search Module into the Base of the Workstation (Figure 2-3.1G).

CAUTION

These PWA's are extremely static sensitive. Be sure to use your Static Wrist Strap.

23. Secure the Card Cage Door and close the Front Door of the Workstation.
24. Tighten the four Screws installed in Steps 9 and 10.
25. Secure the Rear Door of the Workstation.

2-3.2. Cartridge ANSI Transport

CAUTION

The M-654 is shipped with the M-7530/7540 Interface Harness exiting to the left. Reroute the harness to the right for older M-7530's if necessary.

For M-654's prior to S/N 5400207, a ground must be added by installing M-652 Ground Update Kit (78-8059-6608-8).

1. Remove the Front Left Cover, Front Right Cover, Rear Cover, Top Left Cover, Bottom Cover and Control Panel Cover from the M-654.
2. Remove and discard two Screws and the Film Guide Assembly (Figure 2-3.2B).
3. Loosen the Adjustment Screw for the Left Film Roller (Figure 2-3.2A).
4. Pull the Left Film Roller Assembly straight out from the Axis Holder (Figure 2-3.2A) and discard the assembly.
5. Cut the Cable Ty holding the Wiring Harness for the Film Sensor (Figure 2-3.2A).
6. Unplug the Connector for the Film Sensor Wiring Harness (Figure 2-3.2A).
7. Remove and discard the Screw, Lockwasher, Washer, Film Sensor Holder and Film Sensor (Figure 2-3.2A).

Note

Do Steps 8 and 9 only if the M-654 is below S/N 5401070. Otherwise, go on to Step 10.

8. Remove the Screw, Washer, and Plate (Figure 2-3.2B) discarding the Plate but not the hardware.
9. Install the Adjustment Bracket (Item 19) for the Blip Sensor Housing Assembly using the Screw and Washer removed in Step 8 (Figure 2-3.2C).

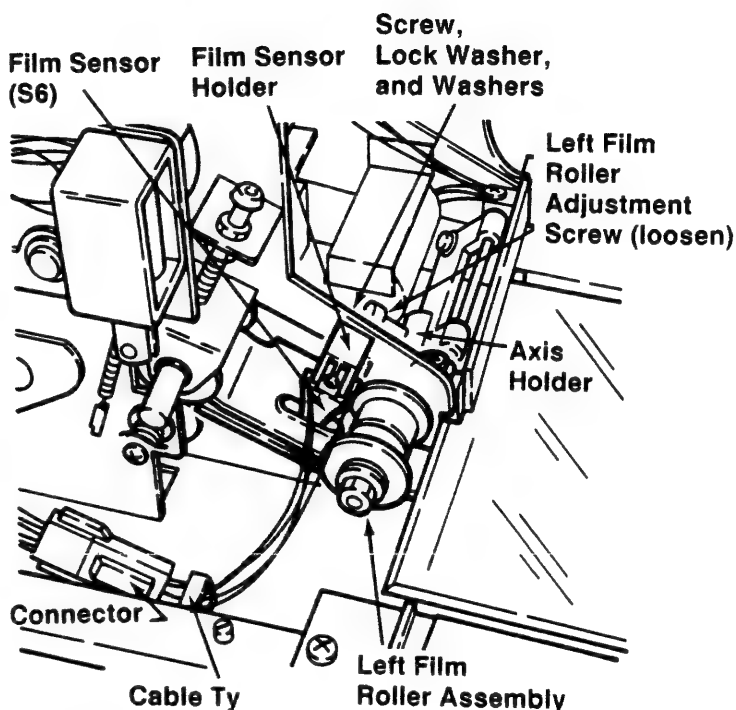


Figure 2-3.2A

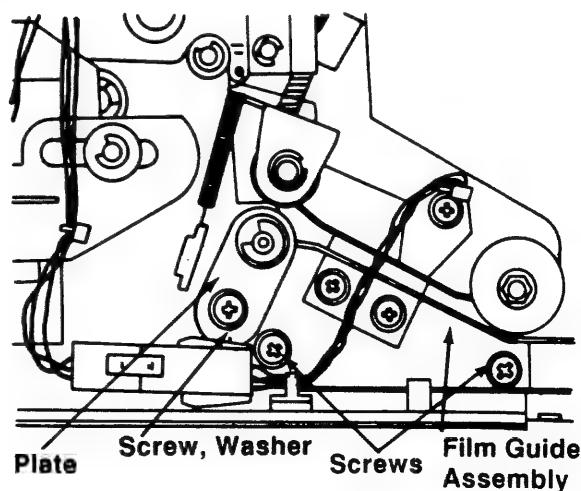


Figure 2-3.2B

10. Loosely install an M4 x 0.7 mm Nut (Item 21) and #6 Plain Washer (Item 15) on the threaded shaft of the Adjustment Bracket (Figure 2-3.C).

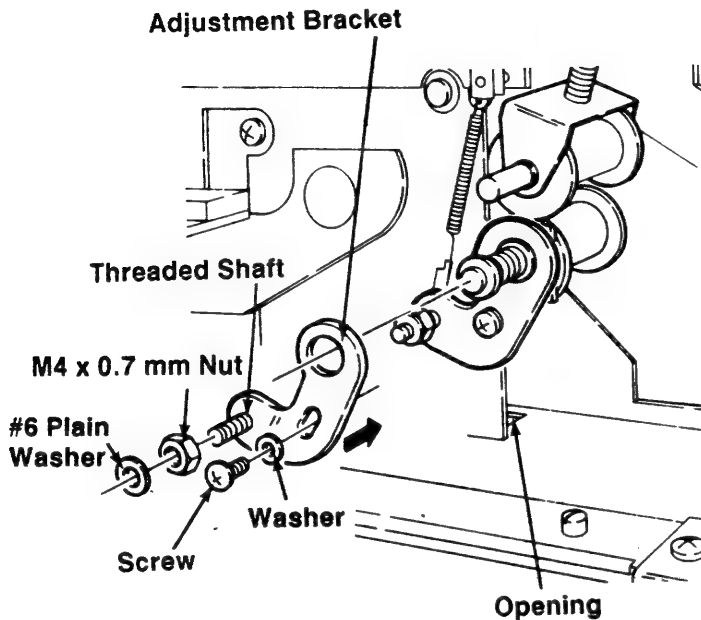


Figure 2-3.2C

11. Route the Blip Lamp Harness and the A Row and B Row Blip Sensor Wiring Harnesses from the Blip Sensor Housing Assembly (Item 7) to the left through the opening in the Base out of the way of the film path (Figure 2-3.2C).

CAUTION

Do not install the Glass Lamp Filter or Sensor Window at this time.

12. Insert the Left Film Roller Shaft of the Blip Sensor Housing Assembly into the Axis Holder allowing the threaded shaft of the Adjustment Bracket to go through the hole in the Blip Sensor Assembly (Figure 2-3.2D).
13. Place the M-656 Roller Adjustment Gauge (Item 20) against the 16 mm flange of the Left Film Roller (Figure 2-3.2D).
14. Push the Left Film Roller and Roller Adjustment Gauge against the frame and tighten the Adjustment Screw (Figure 2-3.2D).

15. Plug the Connector from the Film Sensor with the Connector for the Film Sensor Wiring Harness disconnected in Step 6 (Figure 2-3.2D).
16. Loosely install the second M4 x 0.7 mm Jam Nut (Item 21) on the outside of the Blip Sensor Assembly (Figure 2-3.2D) and move the Adjustment Nut to the front or rear as required so that the Blip Sensor Assembly and frame of the M-654 are parallel (Figure 2-3.2E see next page) and Film Guide is centered on Odometer Roller.

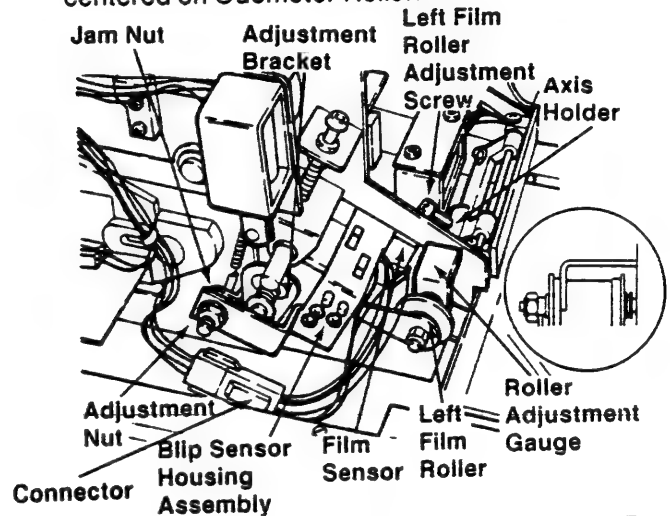


Figure 2-3.2D

17. Tighten the Jam Nut against the bracket of the Blip Sensor Assembly and Adjustment Nut (Figure 2-3.2D).
18. Install the green Glass Lamp Filter (Item 22). See Figure 2-3.2F.
19. Install the clear plastic Sensor Window (Item 23) above the lamp filter. See Figure 2-3.2F.

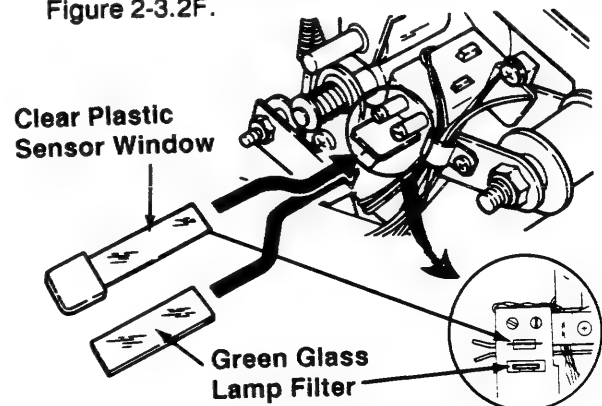


Figure 2-3.2F

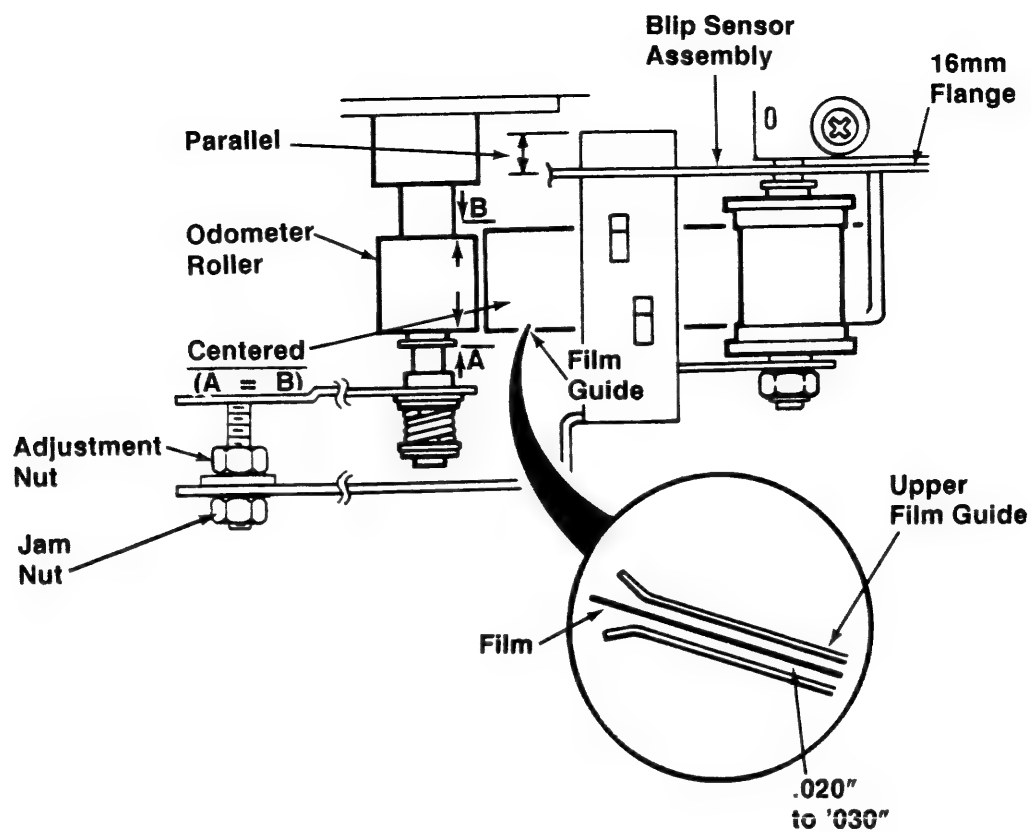


Figure 2-3.2E

20. Place the M-654 on its rear and pull the A Row and B Row Harnesses and Lamp Harness of the Blip Sensor and Housing Assembly through the opening in the Base (Figure 2-3.2C).
21. Mate the A Row and B Row Connectors (J203 and J204) with the Photo Sense Amplifier PWB (Item 9). See Figure 2-3.2G.

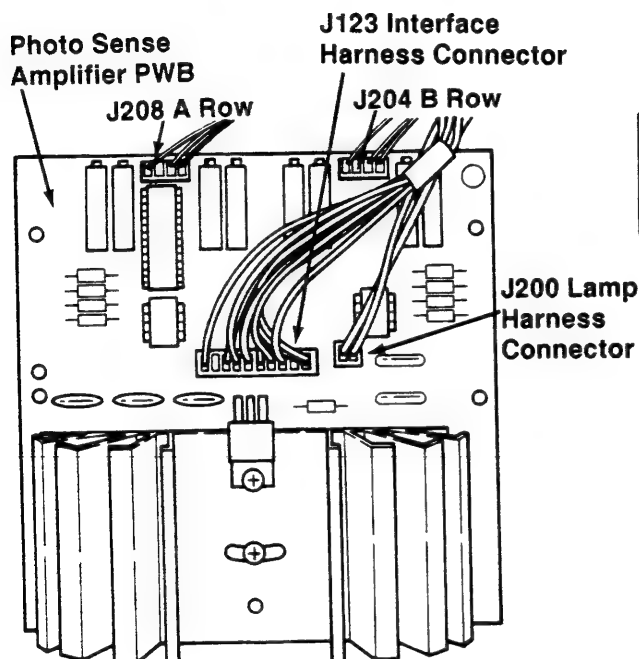


Figure 2-3.2G

22. Mate J200 of the 654 Photo Sense Lamp Harness Assembly with the Photo Sense Amplifier PWB (Figure 2-3.2G).
23. Mate J123 of the 10 position 654 Photo Sense Harness (Item 8) with the Photo Sense Amplifier PWB (Figure 2-3.2G).
24. Remove the "Knockout" from the left rear bottom edge of the Base of the M-654 if necessary (Figure 2-3.2H) and remove any burrs created.
25. Tape the Traverse Bracket (Figure 2-3.2H) if necessary to prevent damage to the insulation of the Wiring Harness.

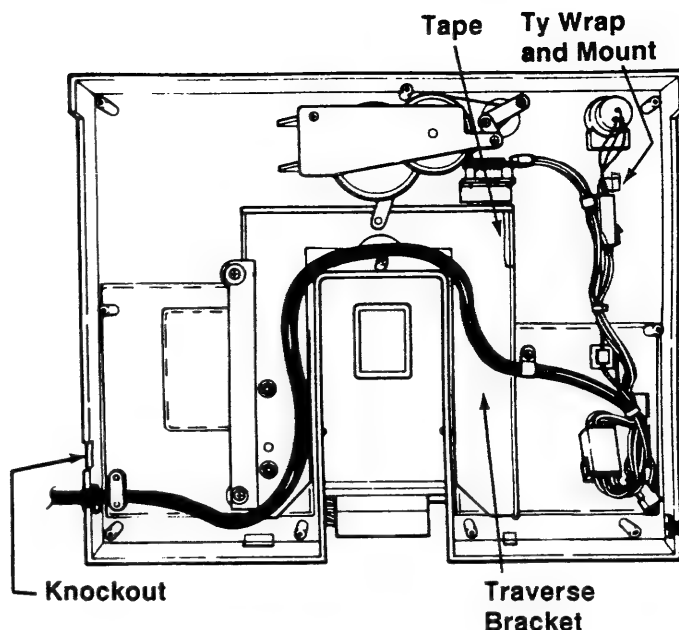


Figure 2-3.2H

26. Cut the Ty-Wrap securing the Wire Harness and remove the Cable Ty Mount (Figure 2-3.2H).
27. Secure the 15 position D-Subminiature Connector P103B of the 654 Photo Sense Harness in the "Knockout" area of the Base of the M-654 with a Jacksocket, Lock Washer, and Nut Kit (Item 16). See Figures 2-3.2I and 2-3.2J. Discard the Plain Washers.

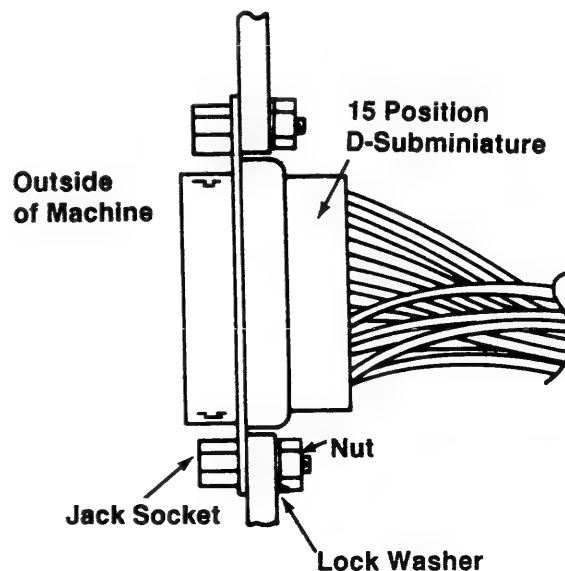


Figure 2-3.2I

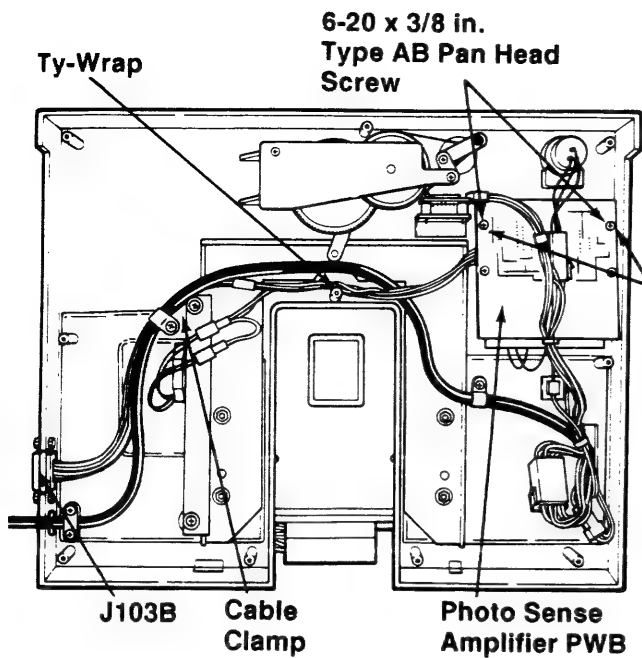


Figure 2-3.2J

28. Install the Photo Sense Amplifier PWB beneath the Wiring Harnesses (Figure 2-3.2J) with four self-tapping screws (Item 10). Add a Washer (Item 12) as a spacer between the board and the frontmost standoffs to allow more space for the Blip Sensor Connectors if needed to position pots in Control Panel Window.
29. Secure all loose wires to the Base Standoffs using three Ty-Wraps (Item 18) and existing Cable Clamp. See Figures 2-3.2J and 2-3.2L.
30. Reinstall the Bottom Cover.
31. Install the M-654 on the Reader-Printer.

Note

Do Step 32 only on M-654s that don't have Decals already installed. Otherwise, go on to Step 32.

32. Remove the protective tape and position the Photo Sense PWB Decal (Item 13) in front of the Blip Photo Sensor Gain Pots (Figure 2-3.2K).
33. Connect the 15 position External 654/656 Interface Harness Assembly from the Page Search to the M-654 and secure with the captive hardware.

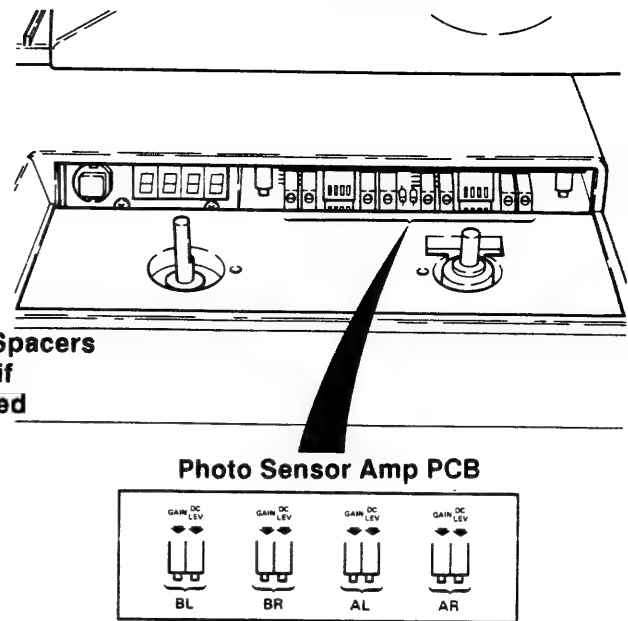


Figure 2-3.2K

34. Connect the 25 position External 7530/654 Interface Harness Assembly from the Page Search to the Reader-Printer and secure with two 4-40 x 3/4 in. Screw Machines (Item 17).
35. Connect the 25 position 654 Photo Sense Lamp Harness Assembly from the 654 to the Reader-Printer, and secure with the captive hardware.

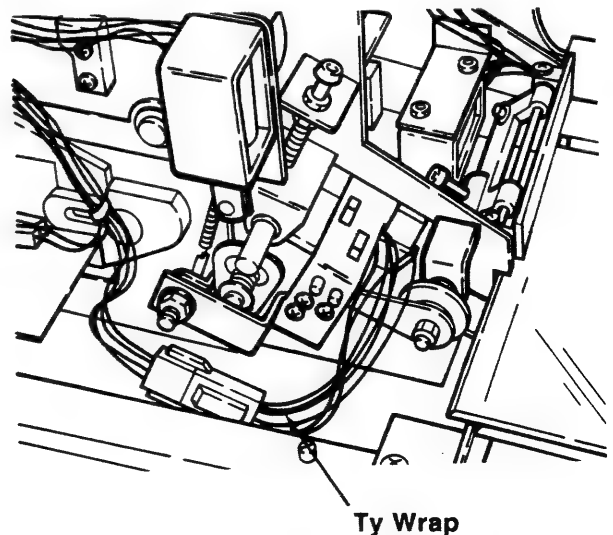


Figure 2-3.2L

2-3.3. Reader-Printer

Note

The following Cautionary Notes may be skipped if the M-656 is being installed on a M-7540.

CAUTION

The wires from Pin 6 on J100 and J101 must be removed on M-7530AJ machines S/N YF61082 to YH612512 and M-7530AB machines S/N YF611082 and later. See orange TB Fiche Technical Bulletins 39-11/87 and 1-2/87 and yellow FCO (Field Change Order) IFC 7530-7 for reference if additional information is needed.

A Prom Kit (78-8051-9741-1) is required for the M-7530 with M-656. Instructions for installing it in all M-7530 machines are included with the kit. Failure to install this PROM will cause Error 051 following a print cycle and no count down on Page Search.

An M-7530 Interface Harness Update Kit (78-8051-9698-3) must be installed on M-7530AJ machines prior to S/N YF610882 and M-7530AB prior to S/N YF611082 before applying power. Recheck the wiring connections. Reverse the bottom connector on M-7530 machines having connectors on the right side (See figure on page 2-ii).

Open the Right Side Door and replace the 5A, 250V Line Fuse to the film handler with a Slo-Blo Fuse having the same rating.

For M-7530's having J100 and J101 on the Left side, the Line Fuse(s) are located within the lower left base (Figure 2-3.3A). Remove the Lower Left Cover for access. For AL machines, replace the 5A, 250V Line Fuse with a Slo-Blo Fuse having the same rating. For AJ machines, replace the 2A, 250V Line Fuse and the 3A, 250V Line fuse with Slo-Blo fuses having the same ratings.

For M-7530's having J100 and J101 on the right side, a Flat Cable Harness (78-8051-9688-4) should be used between the Reader-Printer and Page Search.

Note

The following Cautionary Notes apply only if the M-656 is being installed on M-7530AL or M-7540AL ("International") machines.

CAUTION

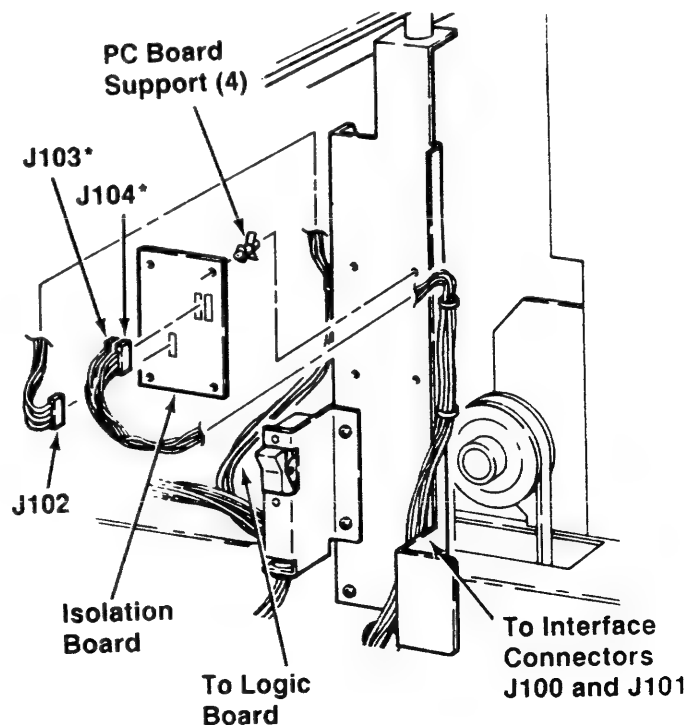
An M-7530 Isolation Board Kit (78-8037-1170-0) must be installed in all M-7530AL machines (S/N YI612633 and up) and all M-7540AL machines.

To install the Isolation Board Kit:

- Remove the Upper Left Cover from the Reader-Printer.
- Install four PC Board Supports (Figure 2-3.3B).
- Install the Isolation Board (Figure 2-3.3B).
- Mate J102 to the connector on the left side of the board (Figure 2-3.3B).
- Mate J103 and J104 to the connectors on the right side of the board. (Figure 2-3.3B)

Note

J103 and J104 are interchangeable.



*Interchangeable

Figure 2-3.3A

Note

Do Step 1 only if J100 and J101 of the M-7530/7540 are secured by Screws, Lockwashers, and Nuts. Otherwise, go on to Step 2.

1. Remove the Lower Left Cover if necessary, remove J100 and J101 and replace the M3 x 6 Taptite Screws with the 4-40 Jacksocket Assemblies (Item 16). See Figure 2-3.3B. You may want to retap the hole before installing the Jacksockets.

Note

J100 and J101 are interchangeable.

2. Replace the Lower Left cover if necessary and connect the 15 position M-7530/7540-656 Interface Harness Assembly from the M-656 to J103 of the M-654 and securing with the two Captive Screws.
3. Connect the 25 position 7530/7540-656 Interface Harness Assembly from the M-656 to J100 or J101 and secure with two 4-40 x 3/16 in. Pan Head Screws (Item 27).
4. Connect the 25 position 7530/7540 Interface Harness from the M-654 to J101 or J100 and secure with two 4-40 x 3/4 in. Pan Head Screws (Item 17).
5. Reinstall all covers and close doors all on the M-7530/7540.

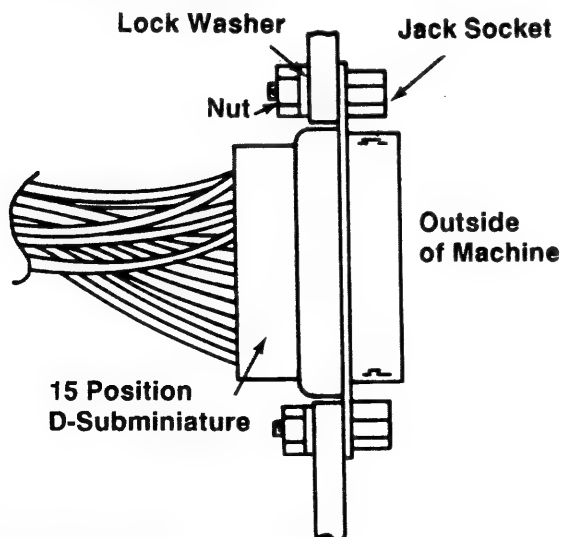


Figure 2-3.3B

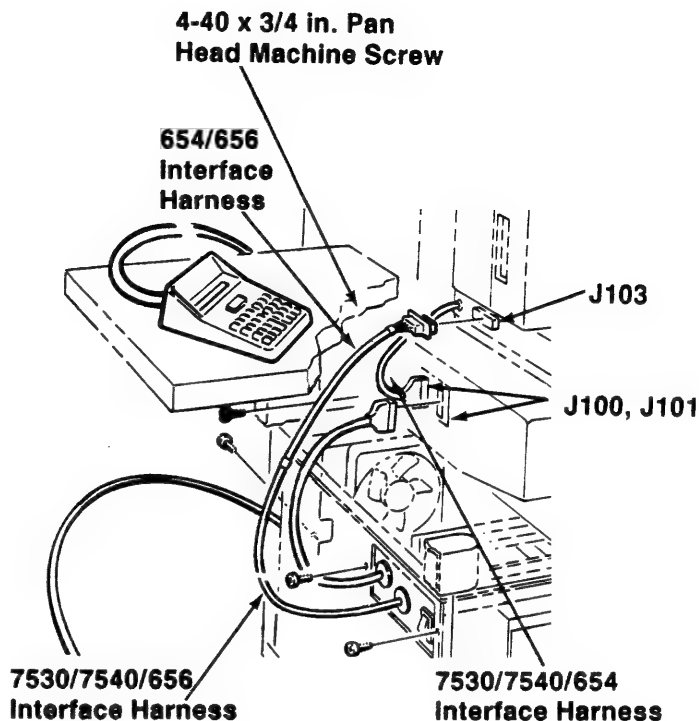


Figure 2-3.3C

2-4. INITIAL CHECK

1. Connect the Power Cord (Item 14) for the M-656 into the Socket at the Rear Door of the Work Station (Figure 2-4A), then plug the Power Cords from the M-7530 or M-7540 and M-656 into suitable power outlets.

Note

The Page Search should always be switched on first and switched off last. If not done in this order, the Reader-Printer will make a print.

2. Switch ON the M-656 (Figure 2-4B).
 - The Search Display should be displayed on the Page Search Keyboard Display.
 - Both Blip Lamps will light.
3. Switch ON the Reader-Printer (Figure 2-4B).
 - The Power Lamp should light.
 - The Viewing Screen should illuminate.
 - The N-P Lamp should light unless the default was changed to P-P.
 - The Warm-Up Lamp should flash, and after 1 minute the Warm-Up Lamp should go out and the Ready Lamp should come on.
 - Various components of the M-654 should actuate.
 - If no further input is given to the machine the Exposure Lamp and Ready Lamp will go out but the Power Lamp, Blip Lamps, Page Search Keyboard Display, and N-P (or P-P Lamp) will remain on.
 - The M-7530 or M-7540 and M-654 displays will be blank unless an error occurs.
 - The Page Search Keyboard will display 0 0 0.

2-5. ADJUSTMENTS

2-5.1. Blip Sensor Assembly Position

1. Load a Test Film Cartridge in the M-654. Film should automatically thread.
2. Loosen the Jam Nut (Figure 2-5.1A) and adjust the Blip Sensor Assembly up or down so that the film is between 0.020 inch to 0.030 inch (0.51 to 0.76 mm) from the bottom surface of the Upper Film Guide (Figure 2-5.1A) and tighten the Jam Nut.

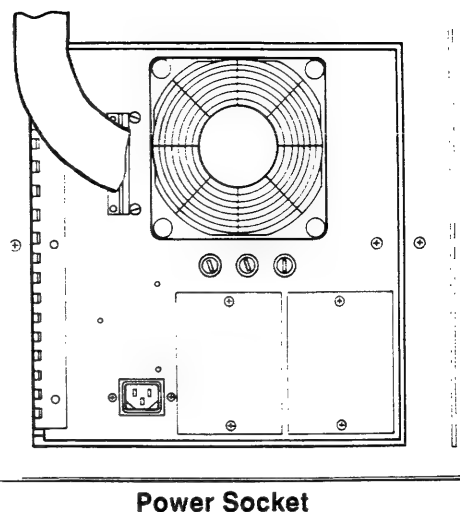


Figure 2-4A

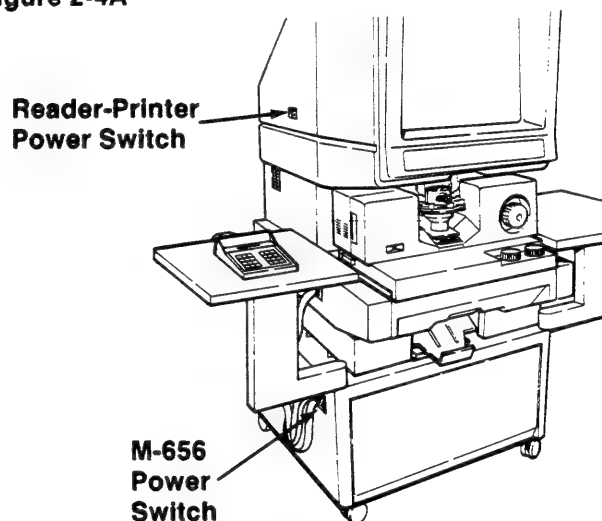


Figure 2-4B

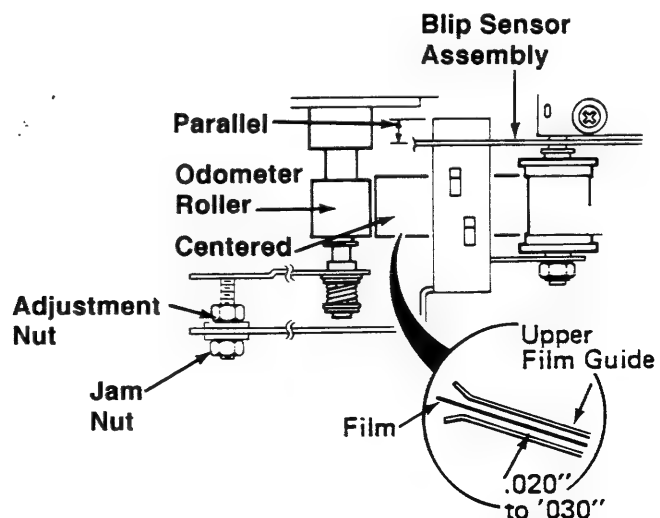


Figure 2-5.1A

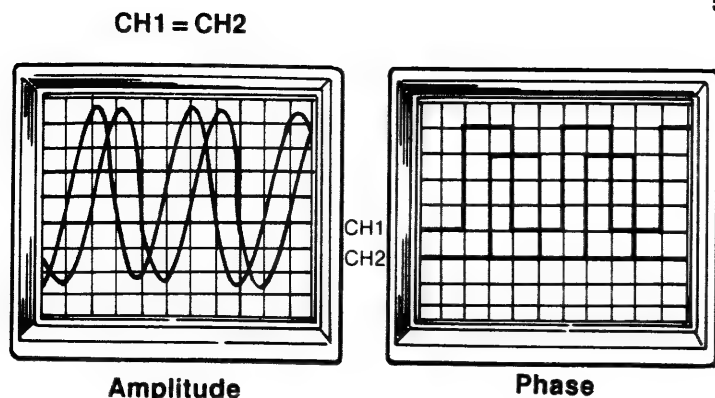


Figure 2-5.2A

2-5.2. Blip Sensing

Note

All Blip Sensing Adjustments have been factory pre-set. the only adjustment necessary at installation would be to "fine tune" the position of the Blip Sensors to the Blip Track of the M-654.

2-5.3. Blip Sensor Position

Note

The A Row Sensor and B Row Sensor should be positioned midway between the extreme upper and lower limits at which blip sensing "falls off".

Special Tools needed are an Oscilloscope, a Three-Level Test Cartridge and Customer Film having typical density and blip positions.

1. Set the Oscilloscope controls as shown in Figure 2-5.3A.
2. Open the M-656 Front Door and Card Cage Door.
3. Connect the Channel 1 Scope Probe to TP4 (A Row Right) and TP5 (GND) on the M-656 Page Search PWB (Figure 2-5.3B).
4. Visually check that both Blip Lamps are on.

5. Set the AC/GND/DC Switch on the scope to GND and adjust the Position Control to center the sweep on the screen, then return the AC/GND/DC Switch to DC.

Load a Three-Level Test Cartridge into the M-654.

Turn the M-654 Film Speed control clockwise to run film at medium speed to obtain a sine wave or "chopped" waveform similar to one of the displays in Figure 2-5.3C.

Note

You may have to adjust the position of the Blip Sensor to obtain these waveforms. Do the system check, page 2-14 before adjusting the Blip Sensor.

8. Turn the A Row Sensor Adjustment Shaft (Figure 2-5.3D) clockwise while observing the scope. Stop turning when the AC portion of the waveform disappears and a dc level is established on the screen (level could be high or low).
9. Turn the A Row Adjustment Shaft counter-clockwise, counting the number of turns, until the AC portion of the waveform begins to disappear again.

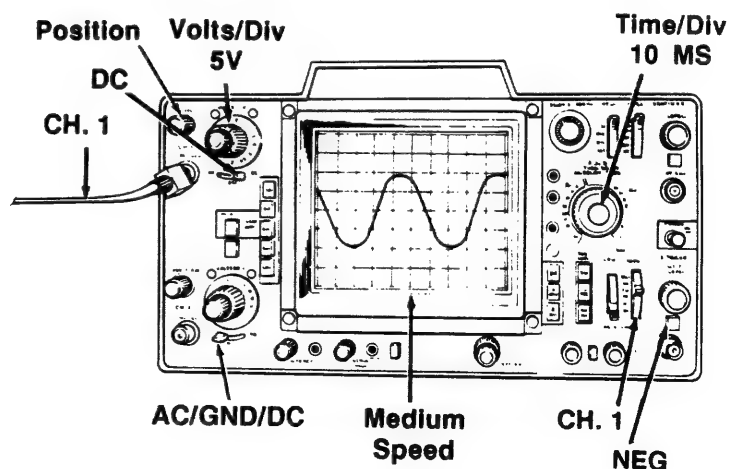


Figure 2-5.3A

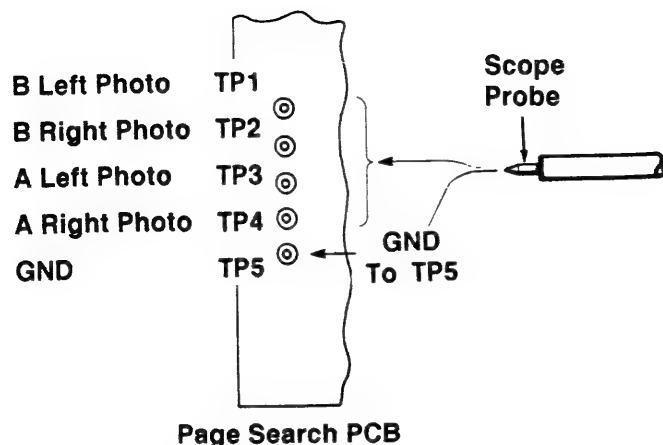


Figure 2-5.3B

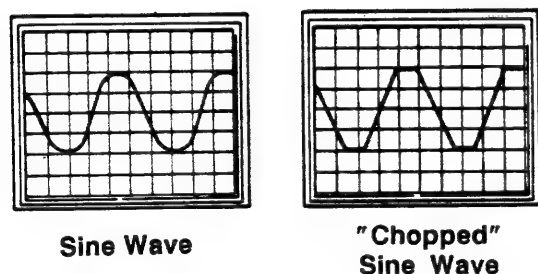


Figure 2-5.3C

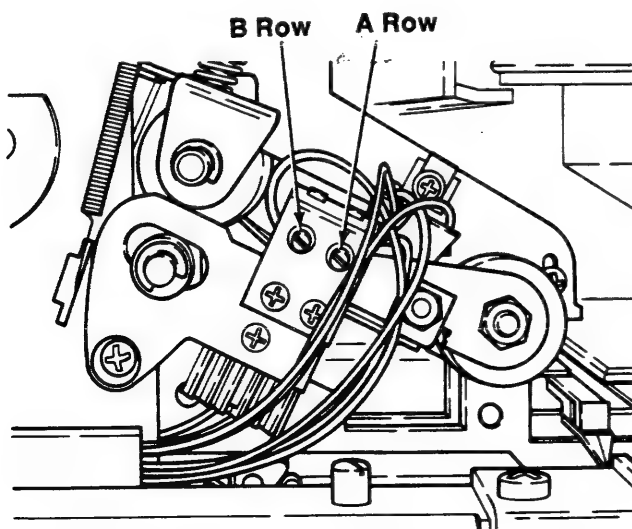


Figure 2-5.3D

8. Divide the number of turns determined in Step 9 by two and turn the B Row Adjustment Shaft clockwise, midway between the two extremes determined in Steps 8 and 9.
9. Connect the Channel 1 Scope Probe to TP3 (B Row Left). See Figure 2-5.3B.
10. Repeat Steps 6 through 8 using the B Row Sensor Adjustment Shaft (Figure 2-5.3D).
11. Change the Time/Div setting on the scope to 2 MSEC/DIV.
12. Run test film at high speed and watch the signal envelope on the scope for dropouts. See Figure 2-5.3E.

Note

Signal Dropouts are caused by film mistracking under the sensors, sensors not positioned over center of blips, and blip track wandering on film (mostly duped film).

13. Repeat Step 12 with the scope probe moved to TP4 (A Row Right).

**Peaks At High Speed
Must Stay In Spec.**

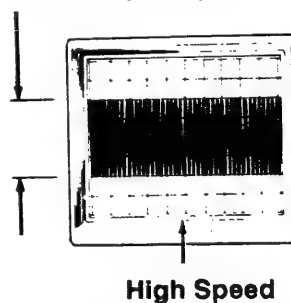


Figure 2-5.3E

2-6. SYSTEM CHECK

1. Run several searches on Three-Level Test Film to check out the search function (default is set for Search Mode 12).
 - If functional problems occur, refer to Adjustment Procedure 3-4 Odometer Sensor (S7), in the M656 Section.
 - If counting problems occur, refer to Troubleshooting, in the M656 Field Service File.
2. If customer film is any mode other than Mode 12, set the System Default Mode (Parameter 0) to match the customer's film. See procedure 2-7.3, How to Examine and Change EEPROM Parameters in the Additional Information Section of the M656 FSF.
3. Set Mode Registration. Using samples of customer's film, set registration for each mode the customer will be using:
 - a. Load film in the M-654.
 - b. Press **1 RUN** on the M-656 Keyboard. Film should be automatically searched to the first Item Blip on the roll.
 - c. Press **3597 L B SET**.
 - d. Using the Manual Scan Control on the M-654 position the first frame within the Print Marks on the Viewing Screen.
 - e. Press **CLR B SET**. Note the number on the M-656 Keyboard.
 - f. Refer to Table 2-1 EEPROM Parameters in the Appendix. Find the Parameter Number that corresponds to the Mode and Row in use for this set-up. For example, if you are in Mode 6 on the A Row, you must change Parameter 137.
 - g. Switch the Write/Disable Switch on the Micro PCB in the Page Search Module to the Write (down) position (Figure 2-6.A).
 - h. Enter **3597L 7000L**.
 - i. Enter the Parameter Number, **B**, the number noted in Step e, and **STOR CLR**.

Note

In the example above, assuming Step e read **1050**. You would enter (from Step h): **3597L 7000L 137 B 1050 STOR CLR**.

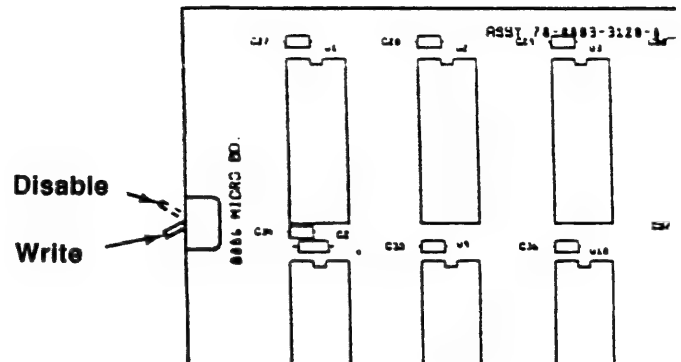


Figure 2-6.A

- j. Press **RUN** to eject the Cartridge, switch OFF both Reader-Printer and M-656, and switch back on again.
 - k. Reload the Film Cartridge and search to the first frame. The image should be properly registered and ready to print.
4. Repeat Step 3 for any other Modes or Rows the customer will be using.
 5. Run several searches and prints using the customer's film.
 6. Replace all covers.
 7. To customize Page Search, refer to the M656 Troubleshooting Section.

Note

If the System Check cannot be performed, return to 2.5.3 Blip Sensor Position, page 2-12 and adjust the Blip Sensor.

2-7. APPENDIX**Note**

Although the following pages may not be necessary for particular installations, familiarize yourself with the procedures for those locations needing special consideration.

2-7.1 Customize the Page Search Firmware

The EEPROM Parameters provide capability for customizing the Page Search Control Program. Parameters relating to a great number of functions can be set in the machine software, as detailed in Table 2-1. The parameters allow you to:

- Set the Default Search Mode.
- Adjust the Memory Register Display Time in 0.01 second intervals.
- Limit the maximum number of prints that can be run during a print cycle.
- Adjust registration (stopping point) of images on the Viewing Screen.
- Enable the software to count blips of non- standard size (See Procedure 2-7.4, How to Calculate a Blip Count Dividing Point).
- Cause the system to ignore Splicing Tabs.
- Set blip polarity (See Procedure 2-7.5, Mode Parameters).
- Set the system to read Film Control (Bar) Codes on film (See Procedure 2-7.6, Reading the Film Control (Bar) Code).
- Plus other options such as Serial Communications, ignore certain error codes, etc.

2-7.2. Set the EEPROM Parameters

1. Examine typical customer film for blip pattern and size (See Field Service File, Theory of Operation, Section 6-3).

Note

For every parameter that is changed from the default value in the following procedures:

- a. Record the **Parameter Number, Special Value**, and any **Comments** on the last page of the Operating Instruction and the last page of the Flip Chart.
 - b. Pull out the Parameter Sheet from the Operating Instructions and tape it to the Card Cage Door.
2. Set the Default Mode (Parameter 0).
 3. Load film and drive it to the image area. Note the position of the images on the film. Change the registration as necessary (Parameters 82 through 99 for the B Row and 132 through 149 for the A Row, depending on the modes used).
 4. Load paper in the machine. The M-7530/7540 will accept 8-1/2 inch by 11 inch or A4 size paper using the appropriate cassette. If the desired paper size is not 8-1/2 by 11 inch, reset Parameter 2.
 5. If the customer desires to limit the maximum number of prints allowed per print request (to less than 99), reset Parameter 130.

2-7.3. How to Examine and Change EEPROM Parameters

The EEPROM Parameters are defined in Table 2-1. Use the following procedure to examine the values stored for particular parameters and change them if required.

1. Press **3597 L 7000 L** on the M-656 Keyboard. The first parameter (000) and the value stored for it (0012, for Mode 12) will be displayed.
2. To sequence through the parameters one at a time, simply press **RUN**. The next parameter will display each time you press **RUN**.
3. To go directly to any parameter, enter the desired parameter number (three digits).
4. To change the value of a displayed parameter:
 - a. Switch the Write/Disable Switch on the Micro PCB to the Write (down) position (Figure 2-7.3A).
 - b. Press **B**.
 - c. Enter the new value (four digits).
 - d. Press **STOR**.
 - e. Press **CLR** to leave the parameter change routine.
 - f. Switch **OFF** the Reader-Printer, then switch **OFF** the M-656.
 - g. Switch the Write/Disable Switch to the Disable (up) position.
 - h. Switch **ON** the M-656, then switch **On** the Reader-Printer.

Note

To display a new parameter after using the **B** Key to change a parameter, you must press the **A** Key before entering the new parameter. (The **A** Key will put you back in the parameter "Addressing Mode".

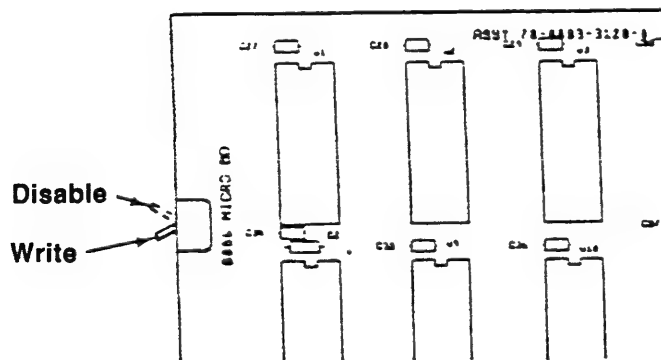


Figure 2-7.3A

TABLE 2-1 EEPROM PARAMETERS

Note

The parameters defined below are the only parameters that you as a Technician are normally involved with. In sequencing through the parameter values stored in the EEPROM, you will see many other values not defined in the table. These are **program software parameters** which you **SHOULD NOT** attempt to change.

Param. No.	Description	Default Value	Options
000	Default Search Mode	0012	0001 to 0018
001	Register Display Time	0050	(1 sec.) 0.01 sec. increments
002	Paper Size in use	0002	0002 = 11 inches 0003 = A4
007	Maximum Allowable Coasting Distance before 400 and 500 Series Error Code	0002	
022	Disable Error 20	0000	0001 = Disabled
029	Maximum Number of Prints	0150	9999 0150 = 9 prints 9999 = unlimited
080	Forward Registration Slow Point		
081	Forward Registration Go Point		
082	Mode 1 Registration, B Row	1283	:
083	Mode 2 Registration, B Row	1283	:
084	Mode 3 Registration, B Row	1283	:
085	Mode 4 Registration, B Row	1283	:
086	Mode 5 Registration, B Row	1283	:
087	Mode 6 Registration, B Row	1283	:
088	Mode 7 Registration, B Row	1283	:
089	Mode 8 Registration, B Row	1283	: Increase Value to Move Image
090	Mode 9 Registration, B Row	1283	: Left Approximately 1/2 inch
091	Mode 10 Registration, B Row	1283	: On Screen at 30X or use 092
092	Mode 11 Registration, B Row	1283	: Procedure 2-7.4
093	Mode 12 Registration, B Row	1283	:
094	Mode 13 Registration, B Row	1283	:
095	Mode 14 Registration, B Row	1283	:
096	Mode 15 Registration, B Row	1283	:
097	Mode 16 Registration, B Row	1283	:
098	Mode 17 Registration, B Row	1283	:
099	Mode 18 Registration, B Row	1283	:
110	Single level, Page Search PCB Mode 5 and multi-level capability	See note	0000 = Single level capability only. 0001 = Page Search has Mode 5 and multi-level capability.
113	IMC Mode Change	0000	Any not-zero value will disable translation of Kodak Mode (in Film Control Code) to 3M Mode (See Table 2-5.)
117	3M F.C.C.: Stop Code lower value	0115	
118	3M F.C.C.: Stop Code lower value/ Start Code higher value	0143	These numbers can be changed to specify shorter or longer lengths for start and stop codes (Version 2.04 software only)
119	3M Film Control Code Start Code higher value	0170	
125	Serial Communication PWB is installed	0000	0001 = Installed
Note:	0000 on 656's - having .61 or lower firmware 0001 on 656's - having 2.04 firmware		

TABLE 2-1 EEPROM PARAMETERS Continued

Param. No.	Description	Default Value	Options
132	Mode 1 Registration, A Row	1283	:
133	Mode 2 Registration, A Row	1283	:
134	Mode 3 Registration, A Row	1283	:
135	Mode 4 Registration, A Row	1283	:
136	Mode 5 Registration, A Row	1283	:
137	Mode 6 Registration, A Row	1283	:
138	Mode 7 Registration, A Row	1283	: Increase Value to Move Image
139	Mode 8 Registration, A Row	1283	: Left Approximately 1/2 inch
140	Mode 9 Registration, A Row	1283	: On Screen at 30X or use
141	Mode 10 Registration, A Row	1283	: Procedure 2-7.4
142	Mode 11 Registration, A Row	1283	:
143	Mode 12 Registration, A Row	1283	:
144	Mode 13 Registration, A Row	1283	:
145	Mode 14 Registration, A Row	1283	:
146	Mode 15 Registration, A Row	1283	:
147	Mode 16 Registration, A Row	1283	:
148	Mode 17 Registration, A Row	1283	:
149	Mode 18 Registration, A Row	1283	:
160	Revision Level		
	Mode 1		
192	Small to Medium Blip Line	0012	See Procedure 2-7.2.
193	Medium to Large Blip Line	0024	See Procedure 2-7.2.
194	Ignore Splicing Tab	0000	0001 = Ignore
195	Large Blip to Splicing Tab	0060	See Procedure 2-7.2.
196	Minimum Blip Size	0002	
197	Mode Parameters	0000	See Table 2-2.
	Mode 2		
200	Small to Medium Blip Line	0012	See Procedure 2-7.2.
201	Medium to Large Blip Line	0024	See Procedure 2-7.2.
202	Ignore Splicing Tab	0000	0001 = Ignore
203	Large Blip to Splicing Tab	0060	See Procedure 2-7.2.
204	Minimum Blip Size	0002	
205	Mode Parameters	0000	See Table 2-2.
	Mode 3		
208	Small to Medium Blip Line	0012	See Procedure 2-7.2.
209	Medium to Large Blip Line	0024	See Procedure 2-7.2.
210	Ignore Splicing Tab	0000	0001 = Ignore
211	Large Blip to Splicing Tab	0060	See Procedure 2-7.2.
212	Minimum Blip Size	0002	
213	Mode Parameters	0000	See Table 2-2.

TABLE 2-1 EEPROM PARAMETERS Continued

Param. No.	Descriptions	Default Value	Options	
Mode 4				
216	Small to Medium Blip Line		0012	See Procedure 2-7.2.
217	Medium to Large Blip Line		0024	See Procedure 2-7.2.
218	Ignore Splicing Tab		0000	0001 = Ignore
219	Large Blip to Splicing Tab		0060	See Procedure 2-7.2.
220	Minimum Blip Size		0002	
221	Mode Parameters		0000	See Table 2-2.
Mode 5				
224	Small to Medium Blip Line		0012	See Procedure 2-7.2.
225	Medium to Large Blip Line		0024	See Procedure 2-7.2.
226	Ignore Splicing Tab		0000	0001 = Ignore
227	Large Blip to Splicing Tab		0060	See Procedure 2-7.2.
228	Minimum Blip Size		0002	
229	Mode Parameters		0000	See Table 2-2.
Mode 6				
232	Small to Medium Blip Line		0012	See Procedure 2-7.2.
233	Medium to Large Blip Line		0024	See Procedure 2-7.2.
234	Ignore Splicing Tab		0000	0001 = Ignore
235	Large Blip to Splicing Tab		0060	See Procedure 2-7.2.
236	Minimum Blip Size		0002	
237	Mode Parameters		0000	See Table 2-2.
Mode 7				
240	Small to Medium Blip Line		0012	See Procedure 2-7.2.
241	Medium to Large Blip Line		0024	See Procedure 2-7.2.
242	Ignore Splicing Tab		0000	0001 = Ignore
243	Large Blip to Splicing Tab		0060	See Procedure 2-7.2.
244	Minimum Blip Size		0002	
245	Mode Parameters		0000	See Table 2-2.
Mode 8				
248	Small to Medium Blip Line		0012	See Procedure 2-7.2.
249	Medium to Large Blip Line		0024	See Procedure 2-7.2.
250	Ignore Splicing Tab		0000	0001 = Ignore
251	Large Blip to Splicing Tab		0060	See Procedure 2-7.2.
252	Minimum Blip Size		0002	
253	Mode Parameters		0000	See Table 2-2.
Mode 9				
256	Small to Medium Blip Line		0012	See Procedure 2-7.2.
257	Medium to Large Blip Line		0024	See Procedure 2-7.2.
258	Ignore Splicing Tab		0000	0001 = Ignore
259	Large Blip to Splicing Tab		0060	See Procedure 2-7.2.
260	Minimum Blip Size		0002	
261	Mode Parameters		0000	See Table 2-2.

TABLE 2-1 EEPROM PARAMETERS Continued

Param. No.	Description	Default Value	Options
Mode 10			
264	Small to Medium Blip Line		0012 See Procedure 2-7.2.
265	Medium to Large Blip Line		0024 See Procedure 2-7.2.
266	Ignore Splicing Tab		0000 0001 = Ignore
267	Large Blip to Splicing Tab		0060 See Procedure 2-7.2.
268	Minimum Blip Size		0002
269	Mode Parameters		0000 See Table 2-2.
Mode 11			
272	Small to Medium Blip Line		0012 See Procedure 2-7.2.
273	Medium to Large Blip Line		0024 See Procedure 2-7.2.
274	Ignore Splicing Tab		0000 0001 = Ignore
275	Large Blip to Splicing Tab		0060 See Procedure 2-7.2.
276	Minimum Blip Size		0002
277	Mode Parameters		0000 See Table 2-2.
Mode 12 (Default)			
280	Small to Medium Blip Line		0012 See Procedure 2-7.2.
281	Medium to Large Blip Line		0024 See Procedure 2-7.2.
282	Ignore Splicing Tab		0000 0001 = Ignore
283	Large Blip to Splicing Tab		0060 See Procedure 2-7.2.
284	Minimum Blip Size		0002
285	Mode Parameters		0000 See Table 2-2.
Mode 13			
288	Small to Medium Blip Line		0012 See Procedure 2-7.2.
289	Medium to Large Blip Line		0024 See Procedure 2-7.2.
290	Ignore Splicing Tab		0000 0001 = Ignore
291	Large Blip to Splicing Tab		0060 See Procedure 2-7.2.
292	Minimum Blip Size		0002
293	Mode Parameters		0000 See Table 2-2.
Mode 14			
296	Small to Medium Blip Line		0012 See Procedure 2-7.2.
297	Medium to Large Blip Line		0024 See Procedure 2-7.2.
298	Ignore Splicing Tab		0000 0001 = Ignore
299	Large Blip to Splicing Tab		0060 See Procedure 2-7.2.
300	Minimum Blip Size		0002
301	Mode Parameters		0000 See Table 2-2.
Mode 15			
304	Small to Medium Blip Line		0012 See Procedure 2-7.2.
305	Medium to Large Blip Line		0024 See Procedure 2-7.2.
306	Ignore Splicing Tab		0000 0001 = Ignore
307	Large Blip to Splicing Tab		0060 See Procedure 2-7.2.
308	Minimum Blip Size		0002
309	Mode Parameters		0000 See Table 2-2.

TABLE 2-1 EEPROM PARAMETERS Continued

Param. No.	Description	Default Value	Options	
Mode 16				
312	Small to Medium Blip Line		0012	See Procedure 2-7.2.
313	Medium to Large Blip Line		0024	See Procedure 2-7.2.
314	Ignore Splicing Tab		0000	0001 = Ignore
315	Large Blip to Splicing Tab		0060	See Procedure 2-7.2.
316	Minimum Blip Size		0002	
317	Mode Parameters		0000	See Table 2-2.
Mode 17				
320	Small to Medium Blip Line		0012	See Procedure 2-7.2.
321	Medium to Large Blip Line		0024	See Procedure 2-7.2.
322	Ignore Splicing Tab		0000	0001 = Ignore
323	Large Blip to Splicing Tab		0060	See Procedure 2-7.2.
324	Minimum Blip Size		0002	
325	Mode Parameters		0000	See Table 2-2.
Mode 18				
328	Small to Medium Blip Line		0012	See Procedure 2-7.2.
329	Medium to Large Blip Line		0024	See Procedure 2-7.2.
330	Ignore Splicing Tab		0000	0001 = Ignore
331	Large Blip to Splicing Tab		0060	See Procedure 2-7.2.
332	Minimum Blip Size		0002	
333	Mode Parameters		0000	See Table 2-2.
650	Ignore Error Code 24 in 3M Code		0000	0001 = ignore

TABLE 2-2 MODE PARAMETERS TABLE

DECIMAL INPUT VALUE	SET BLIP POLARITY		ENABLE DUPLEX PRINTING *		ENABLE FILM CONTROL CODE READING	
	CLEAR BLIPS	DARK BLIPS	REVERSE (B SIDE 1ST)	STANDARD (A SIDE 1ST)	DO NOT COMPARE ROLL NOS.	COMPARE ROLL NOS.
0000						
0001	X					
0003		X				
0004			X			
0005	X		X			
0007		X	X			
0008					X	
0009	X				X	
0011		X			X	
0012			X		X	
0013	X		X		X	
0015		X	X		X	
0024						X
0025	X					X
0027		X				X
0028			X			X
0029	X		X			X
0031		X	X			X
0068				X		
0069	X			X		
0071		X		X		
0076				X	X	
0077	X			X	X	
0079		X		X	X	
0092				X		X
0093	X			X		X
0095		X		X		X

Notes:

1. Select the desired function(s). Then enter the appropriate parameter input value. DO NOT enter a number other than those shown in the table, or results will be unpredictable.
2. See Procedure 2-7.14, for a discussion of Film Control reading, and a description of roll number comparison.

* Not available in first machines.

2-7.4. HOW TO CALCULATE A BLIP COUNT DIVIDING POINT

This procedure uses the M-656 Diagnostics to measure the blip width and set up parameters defining limits that determine whether a blip is counted as an Item, Batch, or Block Blip. The procedure can be used to specify dividing lines between:

- Item and Batch Blips
- Batch and Block Blips
- Block Blips and Splicing Tabs

1. Select MODE on which the film is to be run.
2. Load film and drive to the image area.
3. Use the Film Traverse Control to display the blips on the screen.
4. Locate an area on the film where the different size blips to be measured are adjacent to each other.
5. Key in 3597 L 2013 L to force the display of the Blip Size.
6. Use the M-654 Manual Scan Control to rewind the film about 2.5 turns.
7. Note the rightmost number in the M-654 display. This is the size of the last blip that passed the blip sensor. If slight variations occur, note the average number.
8. Repeat Step 7 for the larger sized blips.
9. Select the number midway between the Item and batch Blip and the Batch and Block Blip and enter these numbers in their respective parameter locations (Table 2-1).
10. Enter 3597L 2020L to reset to normal counting.
11. Check for proper counting.
12. Compare the two count ranges to select a point midway between the upper limit of the range for the smaller blip and the lower limit of the range for the larger blip. For example, assume that:
 - a. The size count for the smaller blip ranges from 10 to 14.
 - b. The size count for the larger blip ranges from 26 to 32.

Note

The image on the screen is about 2.5 turns of the Manual Scan Control from the Blip Sensors. The number displayed on the keyboard will correspond with the image under the Blip Sensors.

To select the dividing point between the two ranges, choose a point midway between 14 and 26 (20). Enter this value (20) in the EEPROM in the location appropriate to the mode.

EXAMPLE: Mode 12 Film

Blip Type	Average Blip Size	Midpoint	Parameter Number and Value
Item	6	12	280 = 0012
Batch	18	26	281 = 0026
Block	34	55	283 = 0055
Splicing Tab	76		

2-7.5. MODE PARAMETERS

Note in Table 2-1 that from Parameter 192 on, the parameters are grouped by Search Mode (Mode 1-18). Each Mode Group contains a parameter entry called Mode Parameters (Parameter 198, 205, etc.). Each of these entries in Table 2-1 refers you to Table 2-2 for an explanation. Table 2-2 explains how to set the desired values for the Mode Parameter selected from Table 2-1. These values have to do with:

Specifying the polarity for blips on the film

This parameter can be set so that the machine will read clear blips on a dark background or dark blips on a clear background, and ignore "fog" or marks on the leader. If the parameter is not used, the machine automatically sets polarity when film is loaded based on the color of the film leader.

Specifying Duplex Printing

If the customer has duplex film and wants separate prints for each row (A Row and B Row) of the film, this parameter must be set. The order of printing can be specified as B Row first, then A Row (standard sequence) or A Row first, then B Row. This feature requires automatic traversing which is not available with the M-654 at this time.

Specifying the Reading of Film Control (Bar) Codes on the Film with or without Roll Number Comparison

See Procedure 2-7.6, Film Control (Bar) Codes.

2-7.6. FILM CONTROL (BAR) CODES

Film Control Code is a "bar-type" code placed on microfilm in the blip channels to convey certain types of information such as search mode, roll number, and preset image address to the control program for the Reader-Printer. The following pages describe two types of Film Control Code:

- Image Management Code (IMC), which is filmed onto microfilm by various competitor's cameras.
- 3M Film Control Code, which is placed on film by the 3M Model 684 Camera.

The latest version M-656 Page Search has the capability of Interpreting either type of control code. Previous versions of M-656 Page Search can interpret IMC code, and, if it has enhanced software, can also Interpret the 3M code.

TO ENABLE FILM CONTROL CODE READING:

Press **3597L 8026L**

Reads 3M Control Code or Kodak Image Management Code (automatically differentiates).

Press **3597L 8025L** to ignore film control codes.

or

Manually move film to scan code. Press **3597L 8038L** to display Roll Number.

Press **CLR** to display Camera Mode.

Note

If control codes are on the film and neither **8026L** or **8025L** are set, the codes will be counted as blips.

2-7.7. IMAGE MANAGEMENT CODE (IMC)

IMC Code consists of two types, illustrated in Figure 2-12A.

- Retrieval Setup Code, which specifies various search parameters relative to the film (see 2-7.7A.)
- Image Address Preset Code, which presets the starting image address on the film (see Table 2-4).

The two types of code, each of which is preceded by start codes and followed by stop codes, are found at the beginning of the roll of film in the A channel. (They also may be placed at the start of the B channel.) Retrieval Setup Code is positioned first on the film, followed by the Image Address Preset Code, if it is used.

2-7.8. IMC RETRIEVAL SET-UP CODE. (See Figure 2-7.7A, and Table 2-3.)

This code specifies in order on the film the following information:

1. Microfilm roll number.
2. Kodak search program (mode) number.
3. Whether splices should be ignored or counted as blips, and whether blips are standard or non-standard size.
4. Image registration data.
5. Blip and image polarity.

If Film Control Code Reading is selected via the EE Prom parameters, the M-656 search program will read the microfilm roll number on the film. It will act upon the data only, however, if a cartridge number has been downloaded to the Reader-Printer. Obviously the machine must be in an API or BPI setup. In this situation the 3M search program will compare the film control code number with the downloaded number. If the numbers disagree, the M-656 keyboard will display error code 220.

Note

This roll number comparison can be de-selected when film control code reading is enabled (see Table 2-2).

The program will also read the search mode number from the film control code, refer to a mode translation table in the 3M software, and convert the Kodak mode number to the appropriate 3M mode number (1-18).

If the film control code number cannot be found in the translation table (see Table 2-5) the M-656 will generate error code 221.

Note

This translation function can be disabled if desired, by means of M-656 parameter 113, in which case the search program will ignore this area in the film control code.

Items 3, 4, and 5 above, although read by the M-656 search program, are ignored, since the subject matter they relate to is handled by M-656 parameters.

Note

Film Control Codes are read when the code passes the Blip sensors. Control Codes are **NOT** read during the Thread-Up Cycle.

2-7.9. IMC IMAGE ADDRESS PRESET CODE (See Table 2-4.)

This code is used to preset the Reader-Printer blip counters to the correct image number if blips on the roll start with any number but one or zero. Coded information includes (in order):

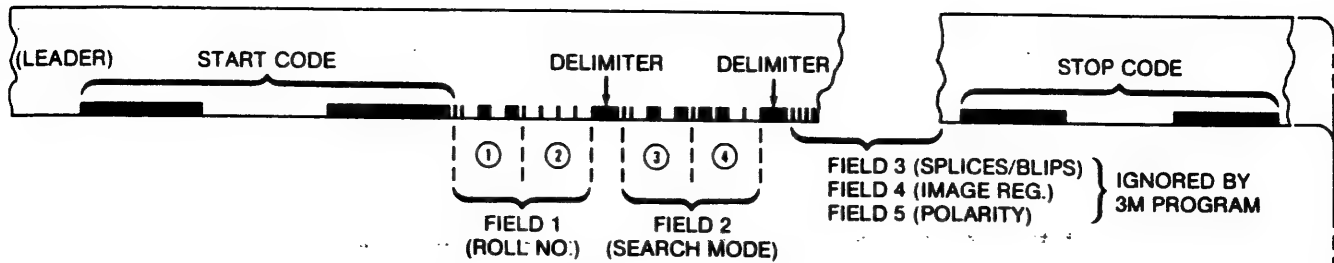
1. The blip level of the coded image address:
 - * Level 1 specifies an item address.
 - * Level 2 specifies a batch address.
 - * Level 3 specifies a block address.
2. The image address (minus 1) of the first blip on the film.
3. The blip level (repeated).

2-7.10. READING THE IMC CODE

The data included in both the Retrieval Set-Up and Image Address Preset codes is in binary format expressed in hexadecimal (hex) codes, as shown in Table 2-6. Each hex character consists of a single byte (eight bits) of single-error correcting/double-error detecting code. **Both spaces and black marks** on the film are used in the coding:

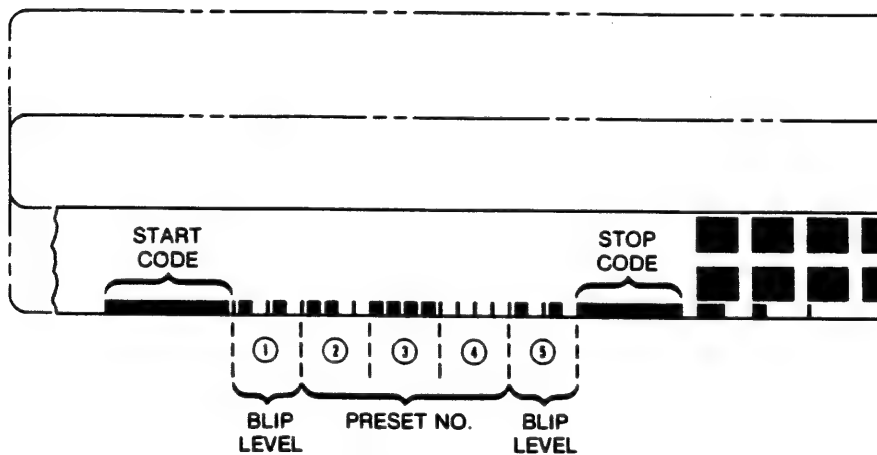
- A binary 0 is denoted by a small mark or space, each the width of an item blip on the film.
- A binary 1 is denoted by a medium mark or space, each the width of a batch blip on the film.
- A delimiter between fields in the Retrieval Set-Up Code is denoted by a large mark followed by a small space on the film. The large mark is the width of a block blip.

To translate the code, the binary data must first be converted to hex. Only the four most significant bits of the binary are used to signify the hex character. Then the hex characters must be converted to decimal. Refer to Procedure 2-7.11, Converting Hex to Decimal for procedures for number conversion.



- ① 00011110 = HEX 1 } HEX 15 = DECIMAL 21.
 ② 01010101 = HEX 5 } THUS, ROLL NO. IS 21.
 ③ 00011110 = HEX 1 } HEX 12 = DECIMAL 18.
 ④ 00101101 = HEX 2 } THUS, SEARCH MODE IS KODAK 18,
 WHICH TRANSLATES TO 3M MODE 10
 (SEE TABLE 5).

RETRIEVAL SETUP CODE



- ① 00110011 = HEX 3 = DECIMAL 3 (BLOCK 3)
 ② 00101101 = HEX 2 }
 ③ 10101010 = HEX A } HEX 2A5 = DECIMAL 677
 ④ 01010101 = HEX 5 } (BLOCK 677)
 ⑤ 00110011 = HEX 3 = DECIMAL 3 (BLOCK 3)

NOTES:

1. BOTH BLACK MARKS AND SPACES ARE USED IN THE BIT CODING.
2. SEE TABLE 6 FOR TRANSLATION OF BIT CODES TO HEX.
3. SEE TABLES 3 AND 4 FOR START AND STOP CODE DIMENSIONS.
4. LARGE BLIP + SMALL SPACE = DELIMITER
 MEDIUM BLIP OR SPACE = 1
 SMALL BLIP OR SPACE = 0

IMAGE ADDRESS PRESET CODE

Figure 2-7.7A IMC Film Control Code

Table 2-3. IMC Retrieval Set-Up Code Fields

Field Description	Code
Start Code	Consists of two 0.750 inch marks separated by a 0.750 inch space, followed by a small space. Polarity of the marks is the same as polarity of image marks on the film.
1. Roll Number	Designated by a code of up to nine hex digits.
Field Delimiter	One large mark followed by one small space. A field delimiter must be used whether or not the field contains data.
2. Search Program (Mode) Number	Designated by a code of up to two hex digits. This specifies the Kodak search mode.
Field Delimiter	Same as above.
3. Modifiers (Space/Blip Size data)	Designated by a code number for eight options relative to ignoring splices or counting them as a particular blip size (Not interpreted by 3M software).
Field Delimiter	Same as above.
4. Image Registration	Designated by a code from 0 to 127 corresponding to a change in film stopping position in 0.0033 inch increments. (Not interpreted by 3M Software.)
5. Image Polarity	Not currently used. A field delimiter is entered for this field.
Stop Code	Consists of two 0.650 inch marks separated by a 0.650 inch space.

Table 2-4. IMC Image Address Preset Code Fields

Field Description	Code
1. Start Code	Consists of one 0.750 inch mark followed by a small space.
2. Index Level	Designates the blip level of the image address number to follow. 1 = item blip, 2 = batch blip, 3 = block blip.
3. Index Value	Designates a preset blip count value for blips to follow (can use up to eight hex characters). In Channel A, the preset address is one less than the blip that follows as the film moves forward in the Cartridge ANSI Transport. In Channel B, if the address is encoded before the first blip in the channel, the address is the same as the first blip as the film moves forward in the machine. For all other locations in Channel B, the address is one less than the blip that precedes it as film moves forward.
Index Level	Same as item 1 above.
Stop Code	Consists of one 0.0650 inch mark.

Table 2-5. Translation of Kodak Search Program to 3M Mode Number

SEARCH PROGRAM NO. (Decimal)	3M MODE NO. (Decimal)
1	14
3	1
4	2
5	1
6	4
7	1
8	2
9	4
10	6
11	8
12	6
13	8
15	6
16	6
18	10
19	12

Note: If the Kodak search program number read is not in the translation table, the 3M software will generate error 0221. 3M parameter 113 can be used to disable translation.

Table 2-6. Binary to Hex Conversion

A7	A6	A5	A4	A3	A2	A1	A0	HEX
0	0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	0	1
0	0	1	0	1	1	0	1	2
0	0	1	1	0	0	1	1	3
0	1	0	0	1	0	1	1	4
0	1	0	1	0	1	0	1	5
0	1	1	0	0	1	1	0	6
0	1	1	1	1	0	0	0	7
1	0	0	0	0	1	1	1	8
1	0	0	1	1	0	0	1	9
1	0	1	0	1	0	1	0	A
1	0	1	1	0	1	0	0	B
1	1	0	0	1	1	0	0	C
1	1	0	1	0	0	1	0	D
1	1	1	0	0	0	0	1	E
1	1	1	1	1	1	1	1	F

Note: The A7, A6, A5, and A4 bits form the hex code.

2-7.11. CONVERTING BINARY TO HEX

Using the four most significant bits of the bar code number, convert the binary value to hex (Refer to Number System Equivalents Table 2-7. For example:

Binary	00101101	10101010	01010101
Hex	<u>2</u>	<u>A</u>	<u>5</u>

Table 2-7 Number System Equivalents

Decimal	Hex	Binary
0	0	0
1	1	1
2	2	10
3	3	11
4	4	100
5	5	101
6	6	110
7	7	111
8	8	1000
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111

2-7.12. CONVERTING HEX TO DECIMAL

Multiply the decimal equivalent of each hex digit by the power of 16 appropriate to the digit's position. Then add the products. For example:

Power of 16 pos:	2	1	0
Hex 2A5	$= (2 \times 16^2) + (10 \times 16^1) + (5 \times 16^0)$		
	$= 512 + 160 + 5$		
	$= 677 \text{ (Decimal)}$		

Note: $16^0 = 1$
 $16^1 = 16$
 $16^2 = 256$
 $16^3 = 4,096$
 $16^4 = 65,536$
 $16^5 = 1,048,576$
 $16^6 = 16,777,216$
 etc.

Contents

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3-2.	Blip Sensor Assembly Position	3-1
3-3.	Film Sensor (S6)	3-3
3-4.	Odometer Sensors (S7)	3-4
3-5.	Blip Sensor Position	3-7
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3-7.	Blip Lamp Voltage	3-12

3-1. GENERAL

Review and understand each procedure before making any adjustments. Refer also to the M-654 Section for Disassembly Procedures if needed. Disassembly procedures in parens are given in this (M-656) Section.

3-2. BLIP SENSOR ASSEMBLY POSITION

Specification

The Blip Sensor Assembly should be parallel with the frame of the M-654 and film should be between 0.020 in. and 0.030 in. (0.51 mm and 0.76 mm) from the bottom surface of the Upper Film Guide.

Special Tools

Feeler Gauge

Measurement

1. Load a Test Film Cartridge in the M-654, Film should automatically thread.
2. Visually ensure the Blip Sensor Assembly is parallel with the frame of the M-654 (Figure 3-2A) and that the Film Guide is centered on the Odometer Roller (Figure 3-2A).

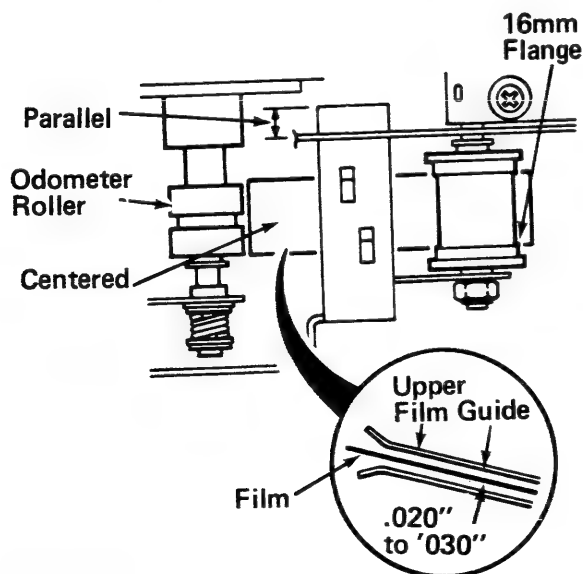


Figure 3-2A

3. Place the Blip Sensor Assembly Adjustment Tool against the 16 mm flange of the Left Film Roller (Figure 3-2A and 3-2B). The tool should touch the frame of the M-654.

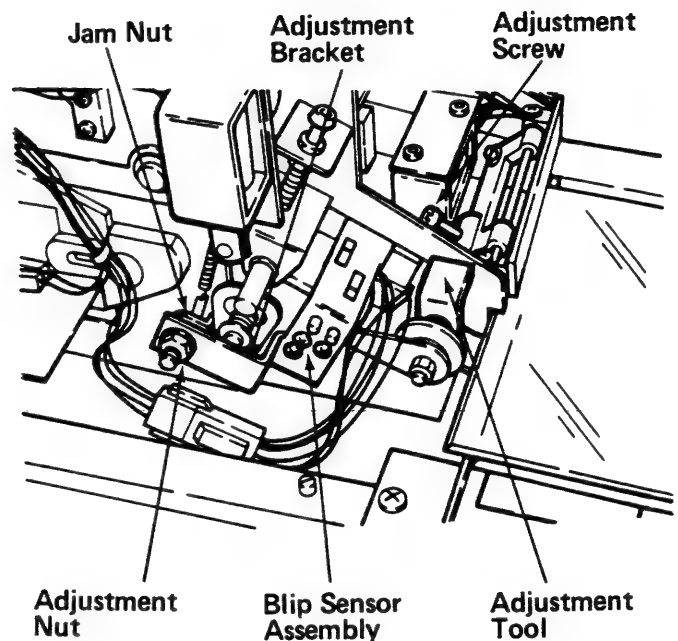


Figure 3-2B

4. Insert a 0.25 in. (0.64 mm) Feeler Gauge between the Upper Film Guide and film. Film should be 0.020 in. to 0.030 in. (0.51 mm to 0.76 mm) from the bottom surface of the Upper Film Guide (Figure 3-2A).

Adjustment

1. Loosen the Adjustment Screw for the Left Film Roller and with the Blip Sensor Assembly Adjustment Tool against the 16 mm flange, push the left Film Roller and tool against the frame and tighten the Adjustment Screw (Figure 3-2A and 3-2B).
2. Loosen the Jam Nut and move the Adjustment Nut and Blip Sensor Assembly to the front or rear as required so that the assembly is parallel with the frame of the M-654.

3. Adjust the Blip Sensor assembly up or down so that the film is between 0.020 inch to 0.030 inch (0.51 to 0.76 mm) from the bottom surface of the Upper Film Guide (Figure 3-2A) and tighten the Jam Nut (Figure 3-2B).
4. Repeat Measurement Steps 2 through 4.

3-3. FILM SENSOR (S6)

Specification

The Film Sensor (S6) should detect the presence of film.

Measurement

1. Switch OFF the M-654 Service Switch.
2. Turn the Film Speed Control to Diagnostic Code 06. The Status Code should read 0.
3. Slip a piece of film up the Film Guide below the Film Sensor (S6). The Status Code should change to 1.

Adjustment

1. Loosen the Adjustment Screw and Nut and reposition the Film Sensor (S6) as required (Figure 3-3A).

Note

The Film Sensor should be perpendicular to the film. Bend the Film Sensor Bracket if necessary.

2. Repeat Measurement Step 3.

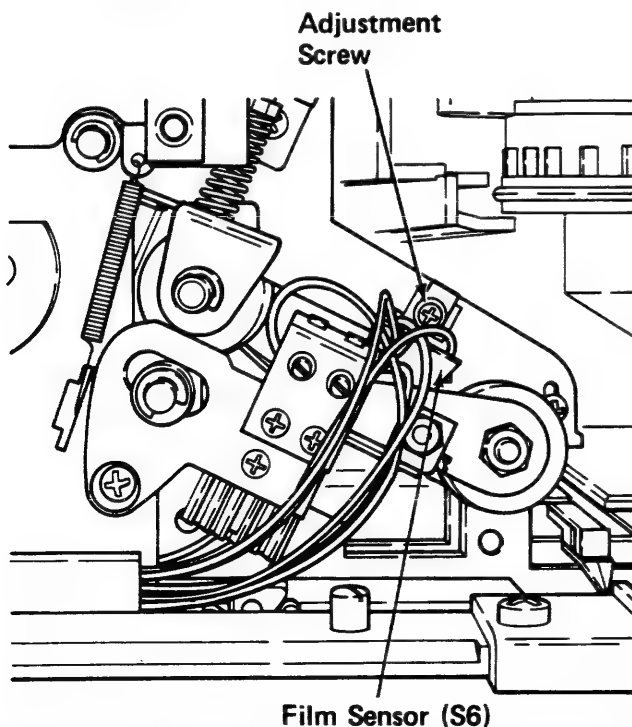


Figure 3-3A

3-4. ODOMETER SENSOR (S7)

Specification

The Encoder Disc must be parallel with the Blip Sensor Slot. The measured voltage between TP201 and TP203, should be between 4 Vpp to 8 Vpp. The Count-Direction Pulse Phase should be 90°.

Special Tools:

Inspection Mirror
Oscilloscope

Measurement

1. Push the Plunger of the Odometer Clutch Solenoid (Y4) to the rear and while turning the Traverse Pulley of the Film Thread Motor (M3), check that the gears mesh smoothly and that the Encoder Disc does not wobble (Figure 3-4A)
2. Turn the Speed Control to Diagnostic Code 17.

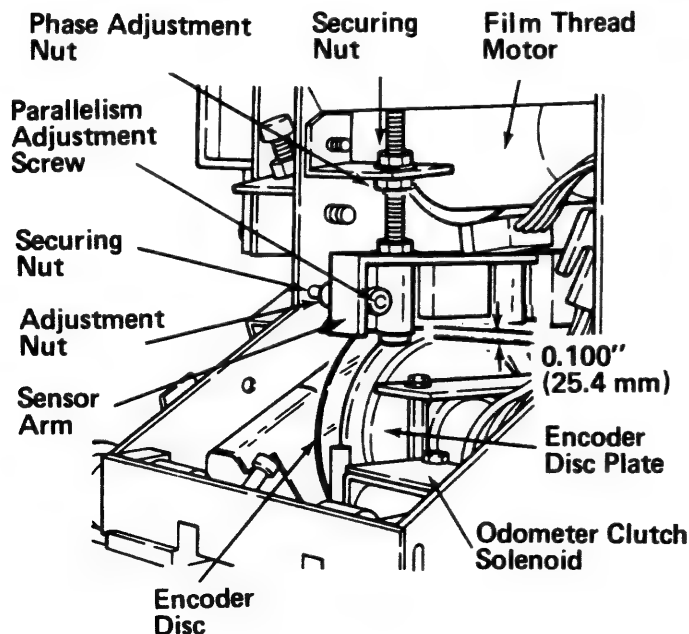


Figure 3-4A

3. While turning the Odometer Roller observe the Odometer/Diagnostic-Status Display. The Status Code should display as described in Table 3-1.

Table 3-1.

Code No.	Direction of Rotation	Status Display
17	Clockwise	17XX(decrease)
17	Counterclockwise	17XX(no change)
18	Clockwise	18XX(no change)
18	Counterclockwise	18XX(decrease)
19	Clockwise	19XX(increase)
19	Counterclockwise	19XX(decrease)

4. Turn the Speed Control to Diagnostic Code 18 and repeat Step 3.
5. Turn the Speed Control to Diagnostic Code 19 and repeat Step 3.

Adjustment

1. Loosen the Securing Nut for the Phase Adjustment Screw (Figure 3-4A).
2. Loosen the Securing Nut for the Parallelism Adjustment Screw and, while holding the Adjustment Nut, turn the Parallelism Adjustment Screw (Figure 3-4A) so that the Encoder Disc is parallel with the Odometer Sensor Slot and as close to the rear as possible without touching (Figure 3-4B).

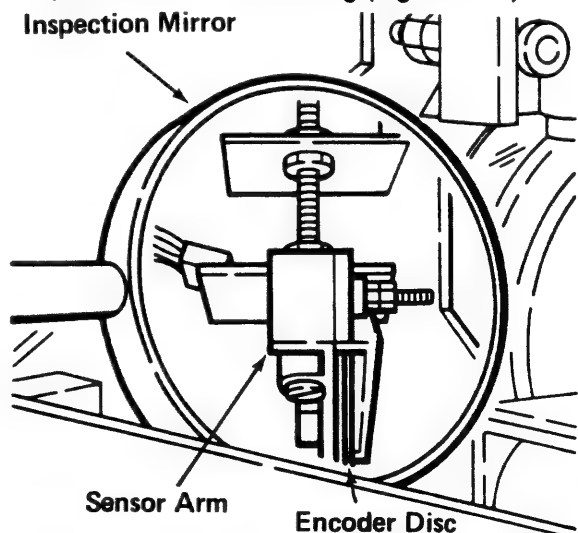


Figure 3-4B

3. Turn the Speed Control to Diagnostic Code 38.
4. Momentarily press the Odometer Reset Button and turn the Speed Control fully counter-clockwise to a 00 Status Code.
5. Turn the Film Speed Control clockwise to Status Code 08.
6. Press and hold the Odometer Reset Button to actuate the Swing Motor (S4).
7. Set the Oscilloscope controls as shown in Figure 3-4C.

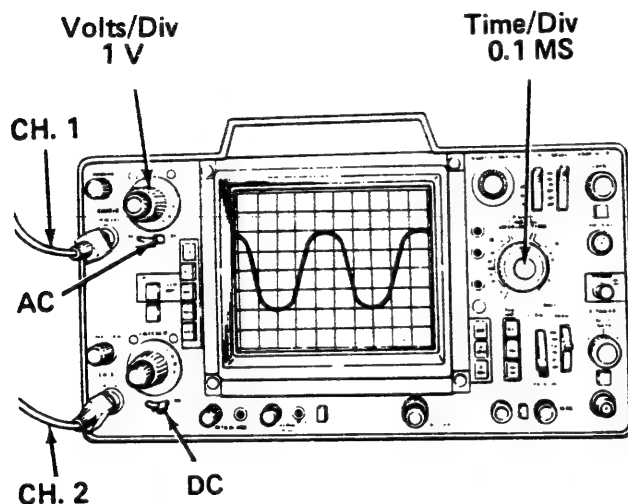


Figure 3-4C

8. Connect the Channel 1 Scope Probe to TP201 on the Peripheral PWB and the Channel 1 Ground to TP131 on the Processor PWA (Figure 3-4D).
9. Connect the Channel 2 Scope Probe to TP220 on the Peripheral PWB (Figure 3-4D). Do not connect the Channel 2 Ground.
10. Turn the Speed Control fully counterclockwise to Diagnostic Code 00 and press the Reset Control Button twice.
11. Turn the Speed Control clockwise to Diagnostic Code 47 and press the Odometer Reset Button.

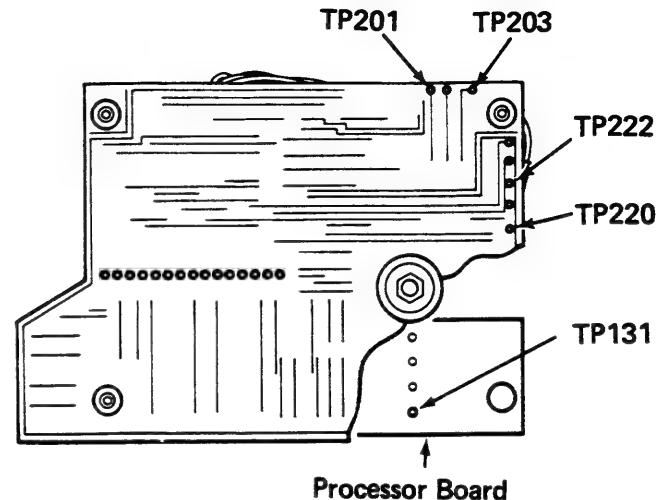


Figure 3-4D

12. Turn the Film Speed Control fully counter-clockwise for a 4764 Status Code.
13. Turn the Film Speed Control clockwise for a 0000 Status Code.
14. Push the Odometer Reset Button to actuate the Odometer Clutch Solenoid (Y4) and Film Thread Motor (M3) to turn the Encoder Disc.

Note

Press the Odometer Reset Button to stop driving the Encoder Disc.

15. While holding the Lock Nut, turn the Amplitude Adjustment Screw, (Figure 3-4E) for a 4 Vpp to 8 Vpp display on the scope (Figure 3-4F).

Note

The Channel 1 and Channel 2 amplitudes need not be the same but should be within spec.

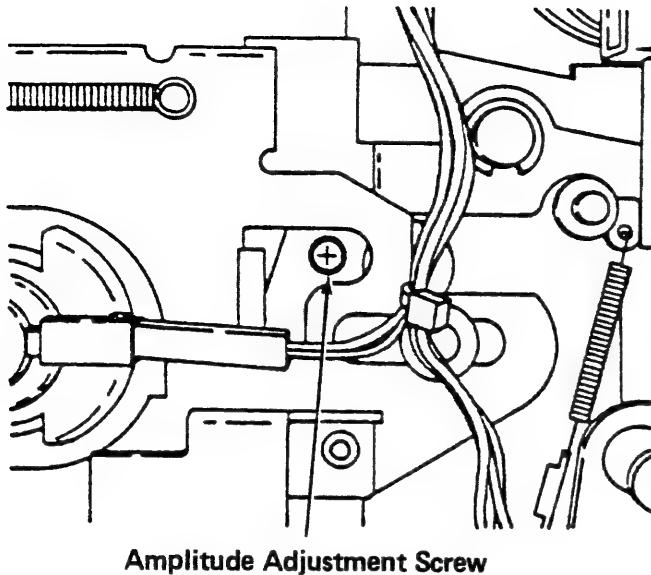


Figure 3-4E

18. Connect the Channel 1 Scope Probe to TP203 on the Peripheral PWB and Ground to TP131 on the Processor PWB (Figure 3-4D).
19. Connect the Channel 2 Scope Probe to TP222 on the Peripheral PWB (Figure 3-4D).
20. Press the Odometer Button Reset to drive the Encoder Disc.
21. While holding the Securing Nut, turn the Phase Adjustment Nut (Figure 3-4A) for a 90° phase relationship (Figure 3-4F).
22. Switch the Service Switch On leaving the Scope Probes attached.
23. Insert a Film Cartridge.
24. Turn the Film Speed Control fully clockwise. Observe on the scope that the square waves will NEVER be in phase. See Figure 3-4F.
25. Turn the Film Speed Control fully counter-clockwise. If the square waves meet, readjust the Phase Angle.

CH1=CH2

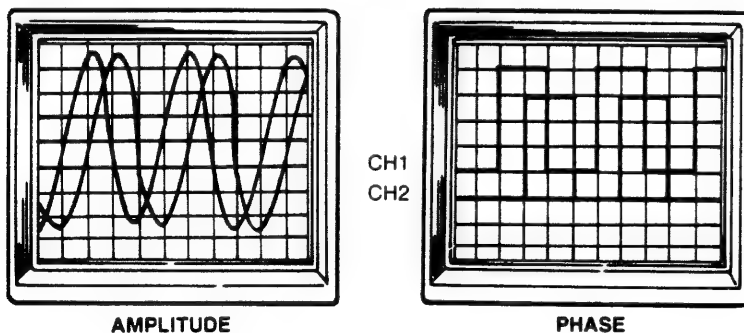


Figure 3-4F

16. Press the Odometer Reset Button to stop driving the Encoder Disc.
17. Repeat Adjustment Steps 1 and 2 and ensure parallelism has been maintained.

3-5. BLIP SENSOR POSITION

Specification

The A Row and B Row Sensors should be positioned midway between the extreme upper and lower positions at which blip sensing "falls off".

Special Tools

Oscilloscope
3-Level Test Cartridge
Customer Film having typical density and blip positions

Measurement/Adjustments

Note

If this procedure is done in conjunction with Blip Photo Sensor Gain Adjustment 3-6, adjust using the film loaded in that procedure (either test film or customer film). However, final Blip Sensor positioning should be done with typical customer film.

1. Set the Oscilloscope controls as shown in Figure 3-5A.

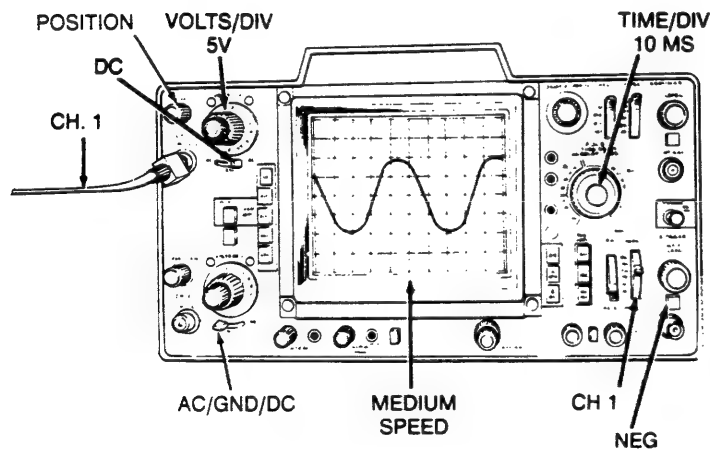


Figure 3-5A

2. Open the M-656 Front Door and Card Cage Door.
3. Connect the Channel 1 Scope Probe to TP1 (B LEFT PHOTO) and TP5 (GND) on the M-656 Page Search PWB (Figure 3-5B).

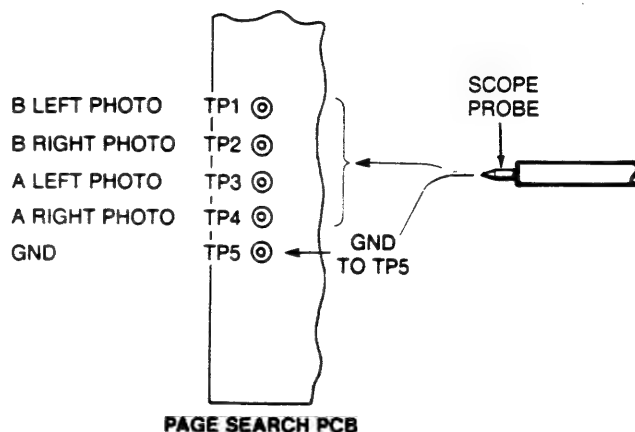


Figure 3-5B

4. Visually check that both Blip Lamps are on.
5. Establish a ground reference at the center of the scope screen by setting AC/GND/DC to GND, adjusting the POS Control, and returning AC/GND/DC to DC (Figure 3-5A).
6. Turn the M-654 Film Speed Control clockwise to run film at medium speed to obtain a sine wave or "chopped" sine wave similar to one of the displays shown in Figure 3-5C.

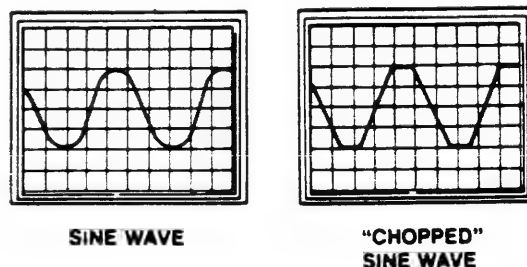


Figure 3-5C

7. Turn the B Row Sensor Adjustment Shaft (Figure 3-5D) clockwise while observing the scope. Stop turning when the waveform begins to distort and decrease in size (Figure 3-5E).

Note

If you cannot obtain either waveform, do Blip Photo Sensor Gain Adjustment 3-6, then return to this procedure.

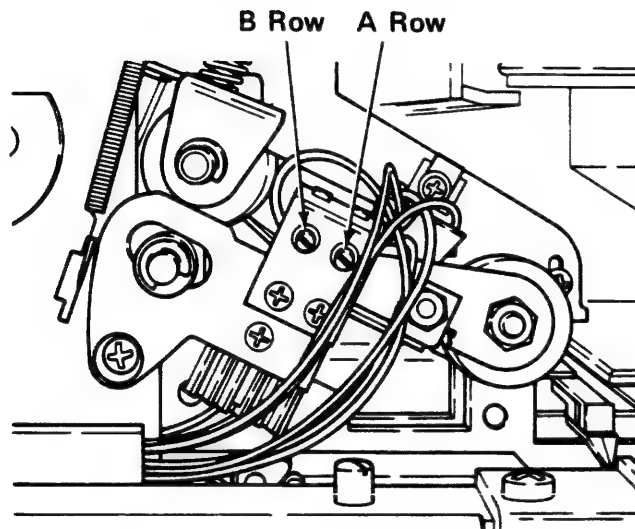


Figure 3-5D

8. Turn the B Row Adjustment Shaft counter-clockwise, counting the number of turns, until the waveform begins to distort and decrease in the other direction.
9. Divide the number of turns determined in Step 8 by two and turn the B Row Adjustment Shaft clockwise, midway between the two extremes determined in Steps 7 and 8.

Note

If this procedure was done using test film, repeat Steps 7 through 9 with customer film having typical density and blip positions.

10. Connect the Channel 1 Scope Probe to TP3 (A LEFT PHOTO). See Figure 3-5A.
11. Repeat Steps 7 through 9 but turning the A Row Sensor Adjustment Shaft (Figure 3-5D).

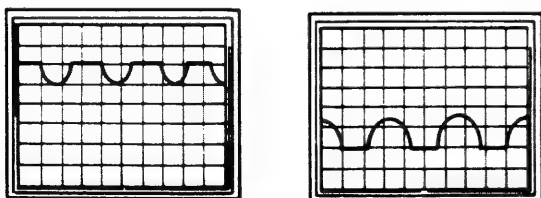


Figure 3-5E

3-6. BLIP PHOTO SENSOR GAIN

Specification

The gain of each of the four Blip Photo Sensor Channels must be a minimum of 18 volts (20 volts optimum) peak-to-peak. If the voltage is higher than 20 volts, debris on the film may be sensed as blips.

Special Tools

Oscilloscope
3-Level Test Cartridge
Customer film having typical density and blip positions

Measurement/Adjustment

Note

Do the following procedure using Test (Specification) Film first. Then repeat the adjustment using customer film having typical density and blip positions to ensure accurate blip counting of customer film.

1. Remove the Control Panel Cover from the M-654.
2. Set the Oscilloscope controls as shown in Figure 3-6A.

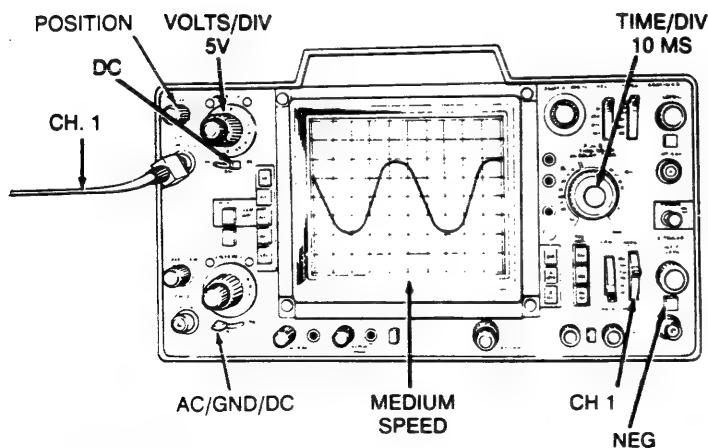


Figure 3-6A

3. Open the M-656 Front Door and Card Cage Door.

4. Connect the Channel 1 Scope Probe to TP1 (B LEFT PHOTO) and TP5 (GND) on the M-656 Page Search PWB (Figure 3-6B).

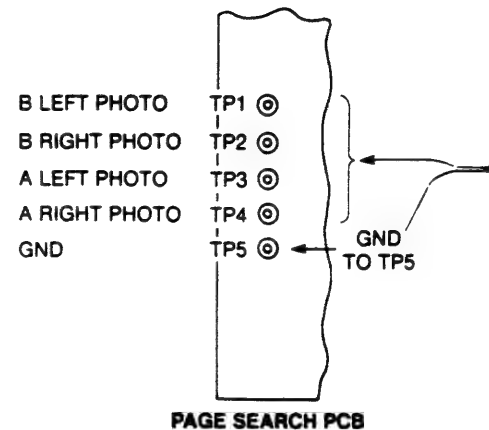
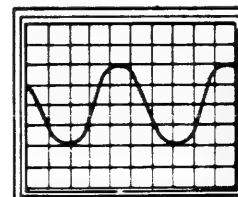
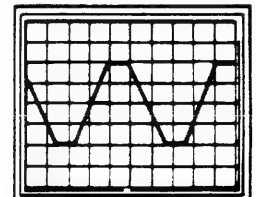


Figure 3-6B

5. Load a Test Film Cartridge.
6. Visually check that both Blip Lamps are on.
7. Establish a ground reference at the center of the scope screen by setting AC/GND/DC to GND, adjusting the POS Control, and returning AC/GND/DC to DC (Figure 3-6A).
8. Turn the M-654 Film Speed Control clockwise to run film at medium speed to obtain a sine wave or "chopped" sine wave similar to one of the displays shown in Figure 3-6C.



SINE WAVE

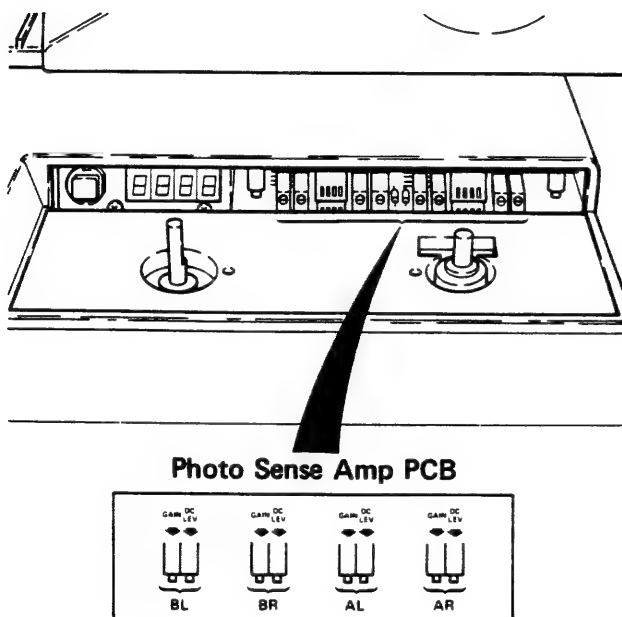


"CHOPPED"
SINE WAVE

Figure 3-6C

B Left Channel

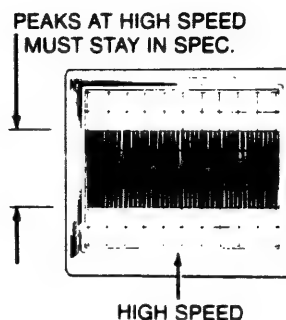
9. Adjust BL GAIN (R27) on the M-656 Photo Sense Amp PWB (Figure 3-6D) clockwise for an optimum amplitude signal of 20 volts peak-to-peak. Adjust BL DC LEVEL (R26) for an equally "chopped" signal on the top and bottom ("Chopped" Sine Wave Figure 3-6C).

**Figure 3-6D****Note**

If you cannot obtain either waveform, turn BL GAIN (Figure 3-6D) fully clockwise until it "clicks". Then, turn BL DC LEVEL (Figure 3-6D) to midrange (seven turns from the end of either extreme). Repeat Step 11. If you still cannot obtain the waveform, do Blip Sensor Position Adjustment 3-5, then return to this procedure.

10. Turn BL DC LEVEL counterclockwise one-half turn to ensure that chopping can be removed. If chopping can be removed within one-half turn, turn BL DC LEVEL clockwise one-half turn. If chopping cannot be removed within one-half turn, lower the BL GAIN.

11. Turn the Film Speed Control clockwise to run film forward at high speed. Observe the scope display for dropouts. The waveform peaks (Figure 3-6E) must all stay within the range determined in Step 9.

**Figure 3-6E****Note**

If the waveform peaks are not within the range determined in Step 9, repeat Blip Sensor Position Adjustment 3-5, check film tracking, and "blip channel wander" on duplicate film.

B Right Channel

12. Connect the Channel 1 Scope Probe to TP2 (B RIGHT PHOTO). See Figure 3-6B.
13. Repeat Steps 8 through 11, except adjust BR GAIN (R25) and BR DC LEVEL (R24) for an equally "chopped" signal on the top and bottom.

A Left Channel

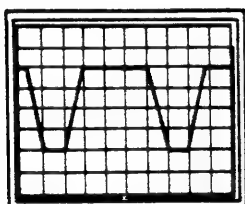
14. Connect the Channel 1 Scope Probe to TP3 (A LEFT PHOTO). See Figure 3-6B.
15. Repeat Steps 8 through 11, except adjust AL GAIN (R23) and AL DC LEVEL (R22) for an equally "chopped" signal on the top and bottom.

A Right Channel

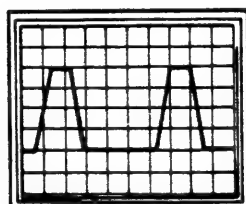
16. Connect the Channel 1 Scope Probe to TP4 (A RIGHT PHOTO). See Figure 3-6B.
17. Repeat Steps 8 through 11, except adjust AR GAIN (R25) and AR DC LEVEL (R20) for an equally "chopped" signal on the top and bottom.

Note

If this procedure was done using test film, rewind film, load customer film having typical density and blip positions and repeat Steps 8 through 17. The waveforms may look different from those observed using test film because of different blip spacing (Figure 3-6F for example). However, peak-to-peak amplitude must be at least 18 volts. If you cannot achieve a signal within specification, the problem may be poor contrast on the customer film.



DARK BLIPS



CLEAR BLIPS

Figure 3-6F

3-7. BLIP LAMP VOLTAGE

Symptoms

Poor blip count

Specification

The voltage for the Blip Lamps should be approximately 5.1 vdc measured at the +5 vdc Fuse on the Rear Door of the Page Search Module. The voltage is adjusted by turning R32 on the Page Search Power Supply PWA.

Measurement

1. Switch ON the M-656.

CAUTION

Be careful of the moving fan blades.

2. Open the Rear Door of the Page Search Module.
3. At the +5 vdc Fuse on the Rear Door, measure approximately +5.1 vdc.

Adjustment

Turn R32 (Figure 3-7A) on the Page Search Power Supply PWA clockwise to increase voltage, counterclockwise to decrease.

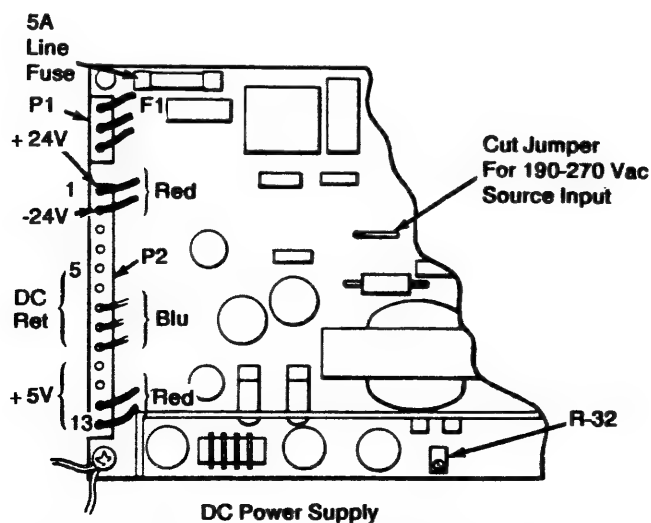


Figure 3-7A

Contents

4-1.	General	4-1
4-2.	Power Supply PWB	4-1
4-3.	Cable Interconnect PWB	4-1
4-4.	Photo Sense Amplifier PWB	4-2
4-5.	Blip Sensor and Housing Assembly	4-2
4-6.	Blip Sensor Assembly	4-3
4-7.	Blip Lamps	4-4

4-1. GENERAL

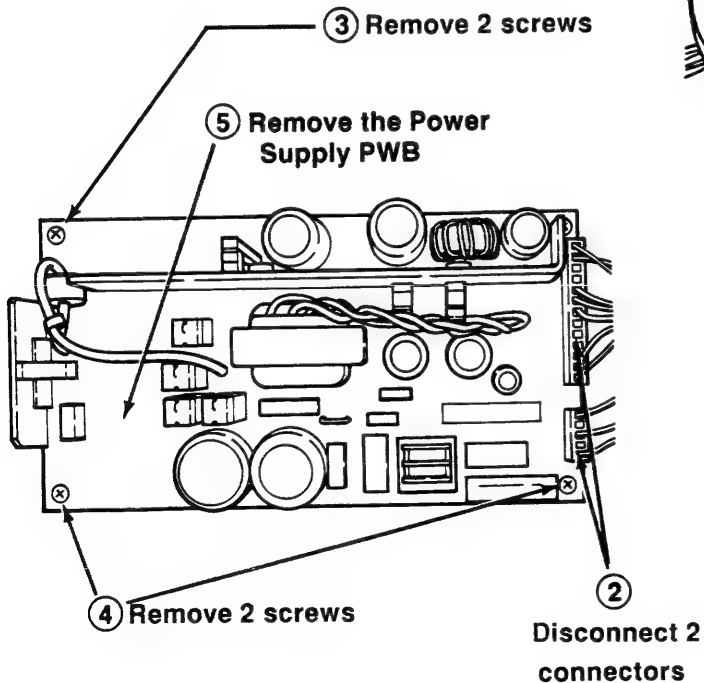
The disassembly procedures in this section are illustrated views with a minimum of supporting text. The order of disassembly is indicated numerically with (1) being the first step, (2) the second step, and so on. Assembly is in the reverse order of disassembly.

Review and understand each procedure carefully before disassembly of any component. Refer to the Disassembly Sections of the M-7530/7540 and M-654 Field Service Files if needed for removal of certain components. Disassembly Procedures shown in parens are given in this Field Service File.

4-2. POWER SUPPLY PWB

WARNING
SWITCH OFF THE PAGE SEARCH AND UNPLUG THE POWER CORD.

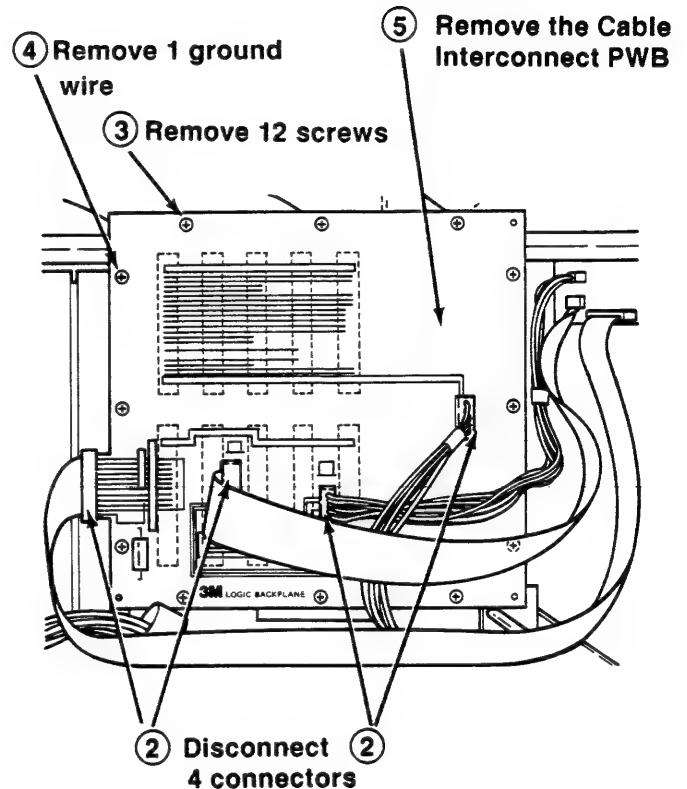
1. Open the Rear Door of the Workstation (1 screw).



4-3. CABLE INTERCONNECT PWB

WARNING
SWITCH OFF THE PAGE SEARCH AND UNPLUG THE POWER CORD.

1. Open the Rear Door of the Workstation (1 screw).

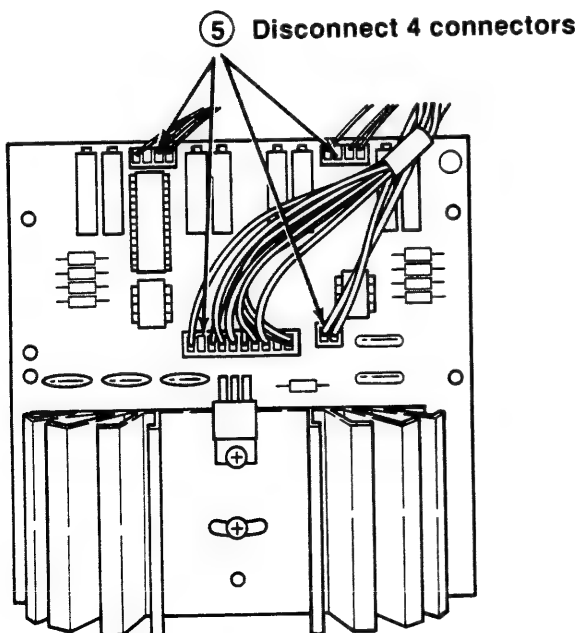
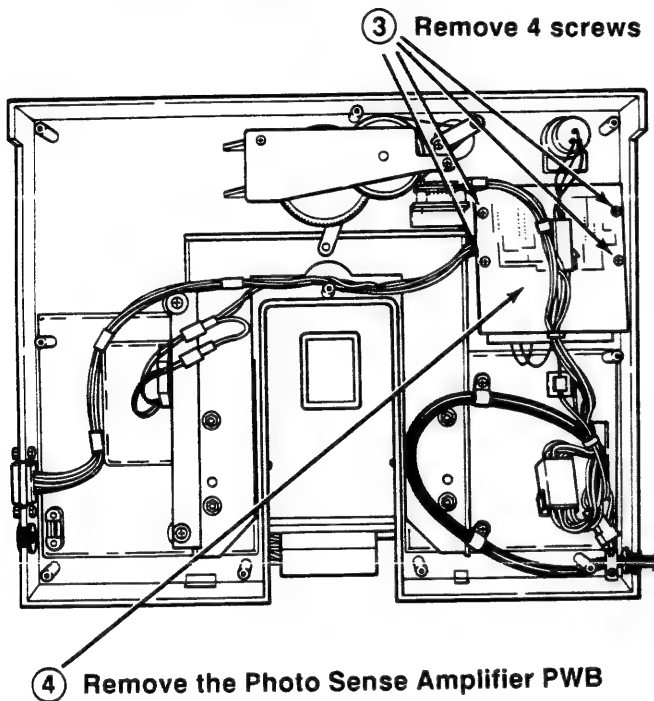


4-4. PHOTO SENSE AMPLIFIER PWB

WARNING

SWITCH OFF THE READER-PRINTER AND UNPLUG THE POWER CORD.

1. Remove the M-654 from the M-7530.
2. Remove the Bottom Cover from the M-654.

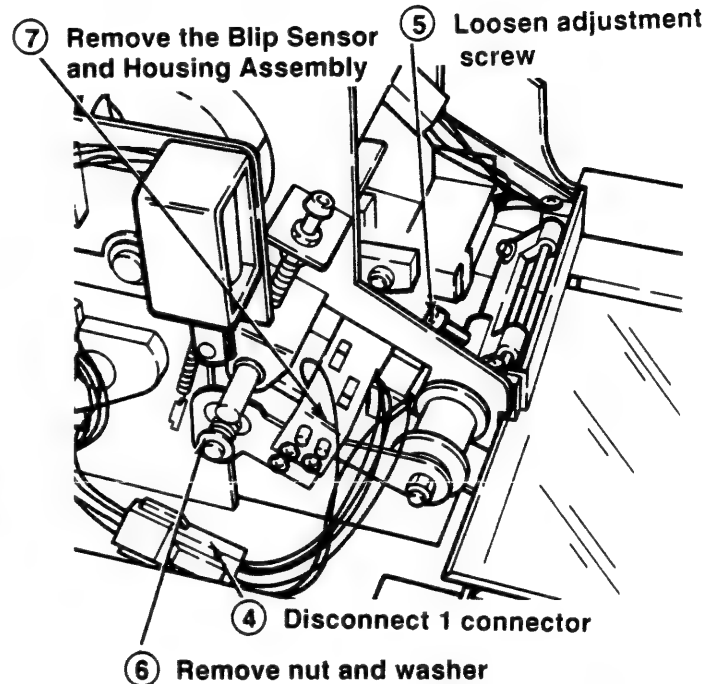


4-5. BLIP SENSOR AND HOUSING ASSEMBLY

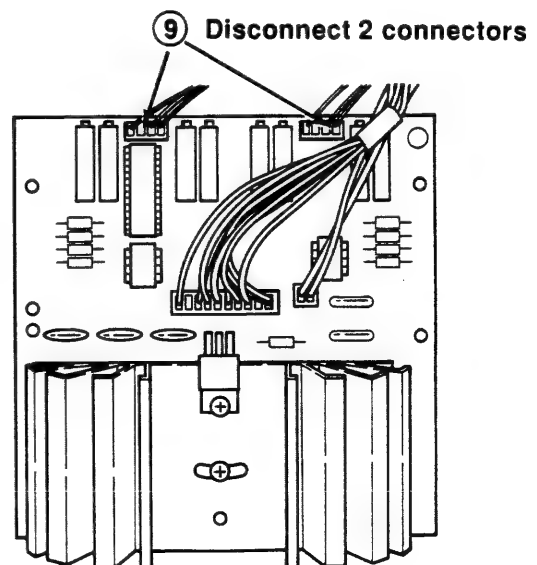
WARNING

SWITCH OFF THE READER-PRINTER AND UNPLUG THE POWER CORD.

1. Remove the Front Left Cover from the M-654.
2. Remove the Rear Cover from the M-654.
3. Remove the Top Left Cover from the M-654.



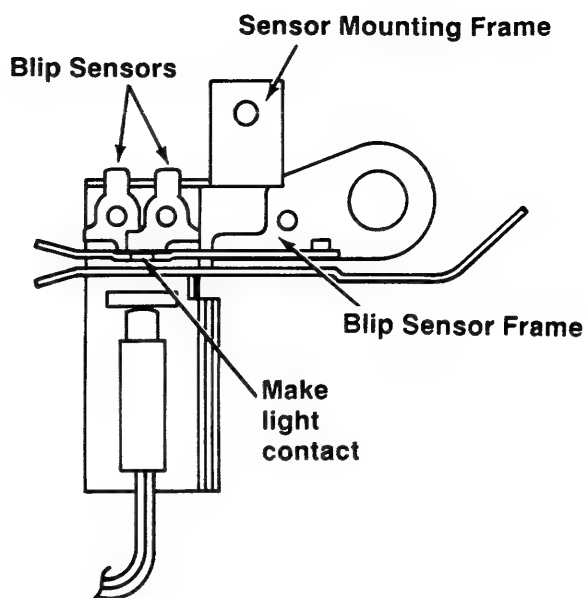
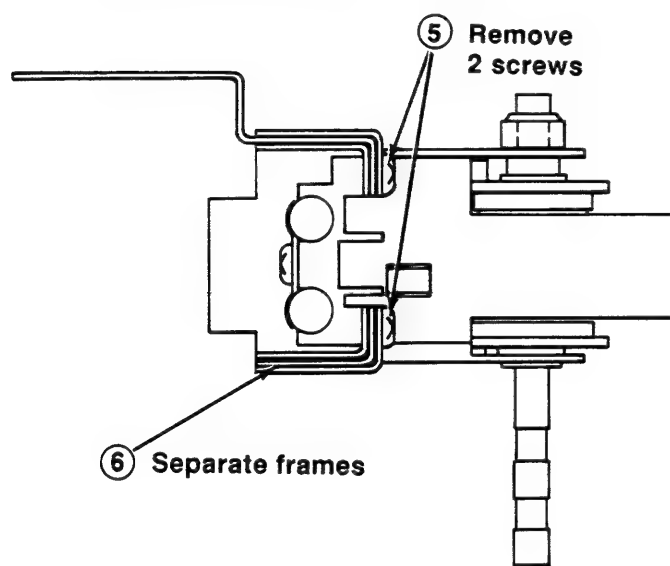
8. Remove the Bottom Cover from the M-654.



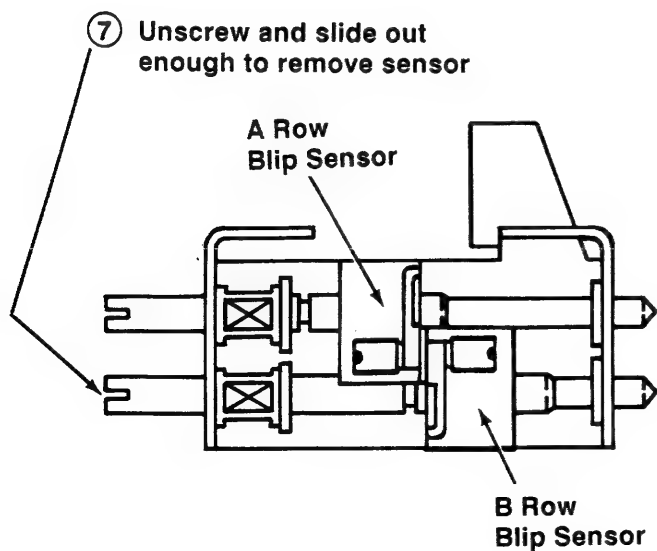
4-6. BLIP SENSOR ASSEMBLIES

WARNING
 SWITCH OFF THE READER-PRINTER AND
 UNPLUG THE POWER CORD.

1. Remove the Front Left Cover from the M-654.
2. Remove the Rear Cover from the M-654.
3. Remove the Top Left Cover from the M-654.
4. Remove the Blip Sensor and Housing Assembly (Disassembly 4-5, page 4-2).

**Note**

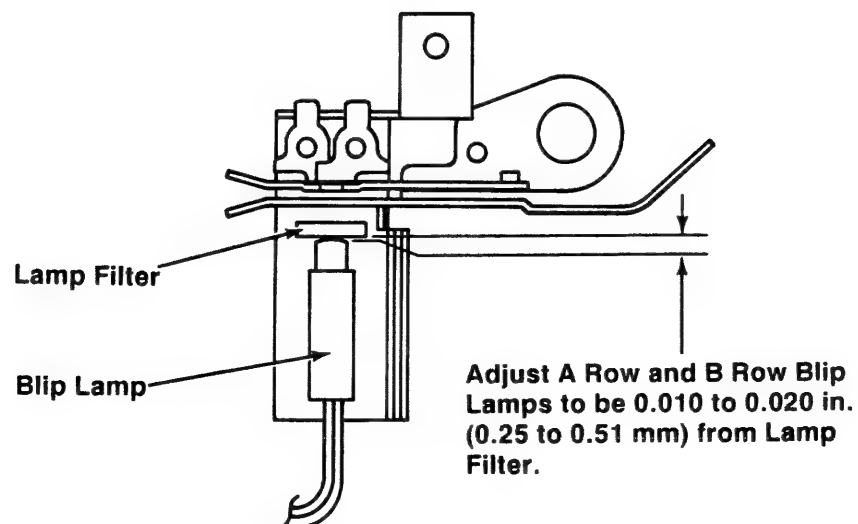
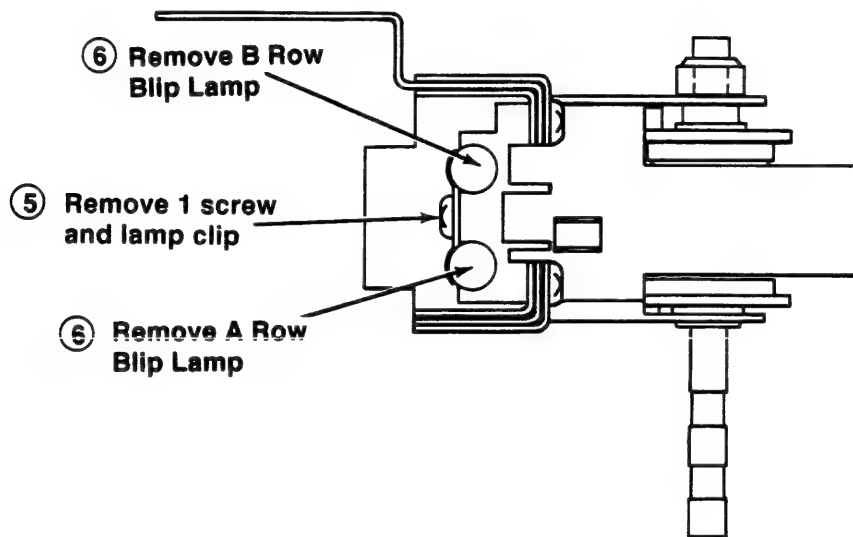
Adjust the Sensor Mounting Frame so that both A Row and B Row Blip Sensors are flush with the Blip Sensor Frame but can move smoothly.



4-7. BLIP LAMPS

WARNING
SWITCH OFF THE READER-PRINTER AND
UNPLUG THE POWER CORD.

1. Remove the Front Left Cover from the M-654.
2. Remove the Rear Cover from the M-654.
3. Remove the Top Left Cover from the M-654.
4. Remove the Blip Sensor and Housing Assembly (Disassembly 4-5, page 4-2).



Contents

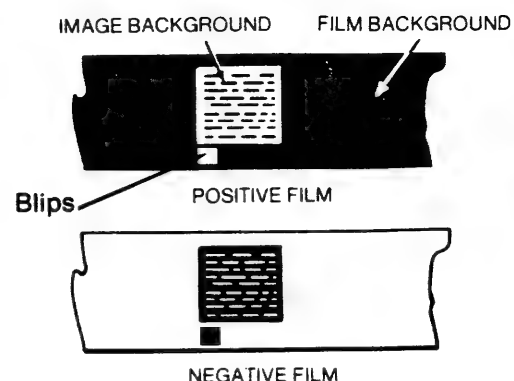
5-1.	Film Preparation	5-1
5-1.1	Film Polarity	5-1
5-1.2	Document Blip Specifications	5-1
5-1.3	Leaders and Trailers	5-2
5-1.4	Winding Film on the Spool	5-2
5-2.	Measuring Blip Width and Spacing	5-2
5-2.1	Using Prints to check Blip Width and Spacing	5-3
5-2.2	Using the Comparator Kit	5-4
5-3.	Film Control	5-5
5-4.	Memory Register/Autoprinting Exercise	5-12
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5-1. FILM PREPARATION

5-1.1. Film Polarity

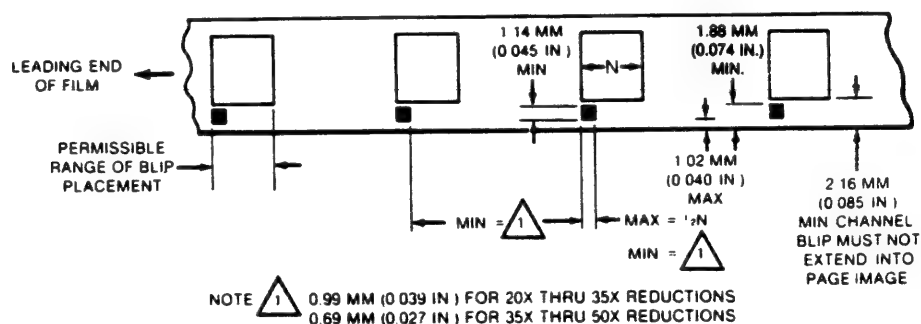
The M-654 "210 CAT" will handle either positive or negative ANSI cartridges.

- On **positive** film, the background of the filmed image is clear and the image is dark. Normally the background of the film itself is dark. If it is, the blip must be clear.
- On **negative** film, the background of the filmed image is dark and the image is clear. Normally, the background of the film itself is clear. If it is, the blip must be dark.

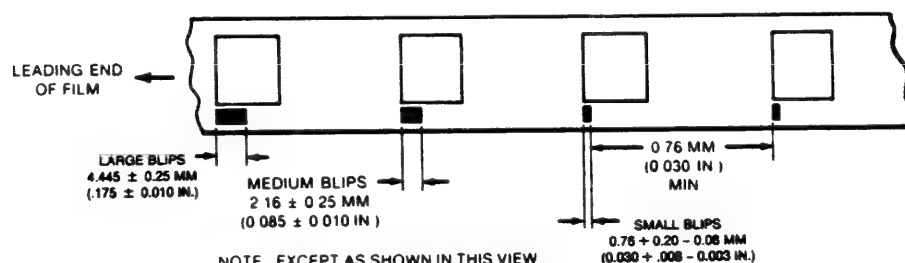


5-1.2. Document Blip Specifications

The illustrations below show the requirements for size and placement of document blips on 16 mm film.



FILMS WITH BLIPS OF ONE SIZE (ANSI/NMA MS8-1979 STANDARD)



FILMS WITH MULTI-SIZE BLIPS

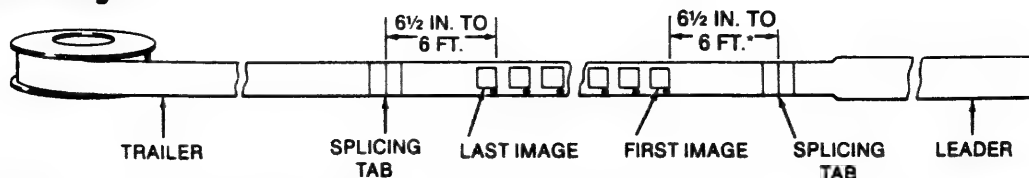
Blip and Film Density Specifications

FILM	MINIMUM DENSITY OF OPAQUE AREA	MAXIMUM DENSITY OF CLEAR AREA
Silver Halide*	1.2	0.25
Diazo*	1.2	0.2
Vesicular**	1.5	0.25
Dry Silver**	0.9	0.2

*Visual diffuse transmission density.
**Measured with a projection densitometer having a 1/4.5 optical system.

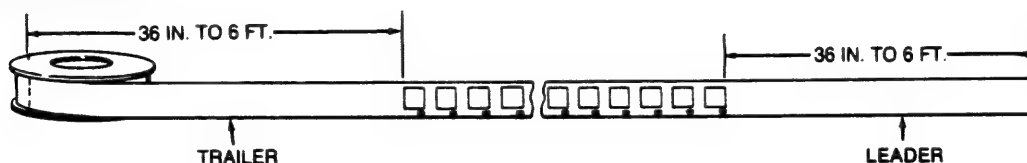
5-1.3. Leaders and Trailers

3M Cartridge:



- NOTES:**
1. Use either clear leader (78-8000-2508-7) or opaque leader (78-8000-8759-1).
 2. Use opaque splice for trailer on films with clear background.
 3. Typical length of film in a cartridge: 100 feet for film of 5 mil thickness. 200 feet for film of 2.5 mil thickness.
 4. *This is the recommended distance. However, depending on 3M equipment used, 2 to 27 inches may be acceptable. Consult your 3M rep for details.

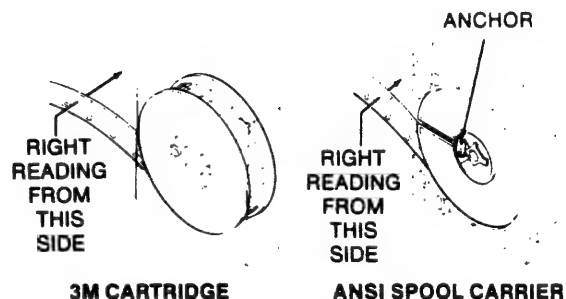
ANSI Spool Carrier



5-1.4. Winding Film on the Spool

Film must be wound on spools so that images are "right-reading" from the direction shown in the figure on the right.

- For 3M Cartridges: Splice the end of the film to the trailer attached to the spool hub.
- For ANSI Spool Carriers: Lock the trailing end of the film to the spool hub with an Anchor.



5-2. MEASURING BLIP WIDTH AND SPACING

In the 3-size and 2-size blip search modes, blip width and spacing are critical to accurate counting.

If the system miscounts on customer film, search on **test** film to determine whether the customer film or the machine is at fault. If the machine counts properly on the test film, use the following procedure to verify that the customer film is defective.

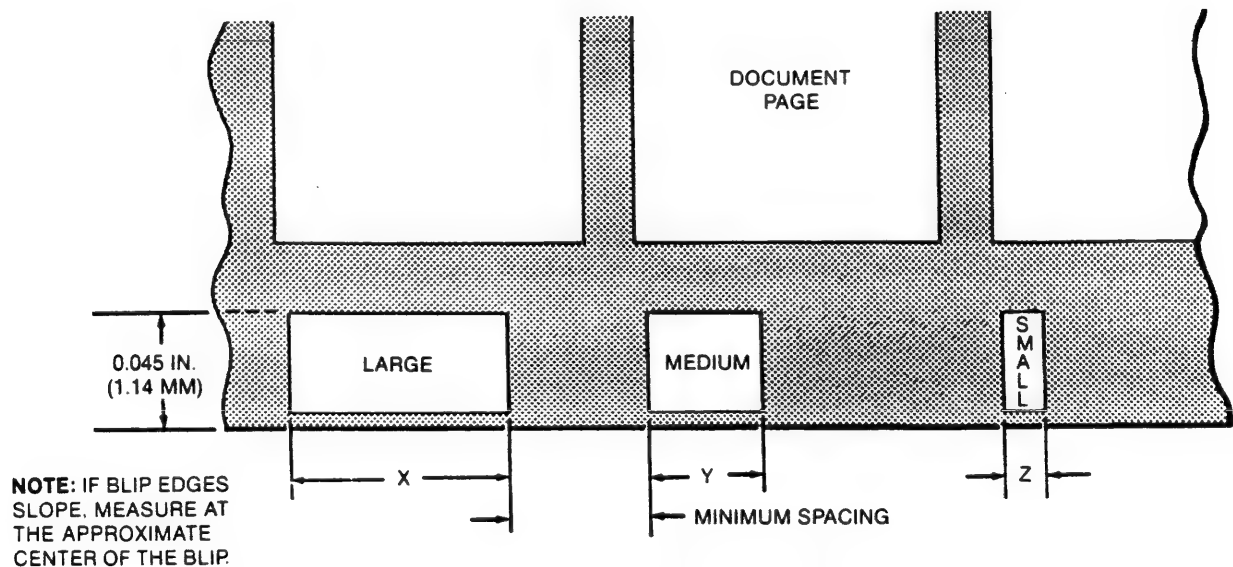
5-2.1. Using Prints to Check Blip Width and Spacing

1. Use the following (or similar) method to locate the area on film where miscounting occurs:
 - a. Load film and search to Item 1 in Batch 1.
 - b. Search to an Item near the end of Batch 1.
 - c. If the count is accurate, return to Item 1, then search to an Item near the end of Batch 2.
 - d. If the count is accurate, return to Item 1 in Batch 1. Then, search to an Item near the end of Batch 3.
 - e. Continue to search through Batches and Blocks, in 3-size blip mode) until miscounting occurs. When miscounting occurs, search within a Batch to locate the faulty area on the film.

Note

The procedure above is a general guideline for isolating a faulty area on film. The actual procedure used will vary with the Block and Batch format of the particular roll of film.

2. Visually compare the suspected blips on the screen with blips in the same area.
3. Traverse the blips into the print area on the screen. Then make prints of the suspected blips.
4. Measure the blips on the prints as shown in Figure 5-2.1A. If blip width or spacing is not within specification, notify the customer.



PROCEDURE:

1. MEASURE BLIP WIDTH IN INCHES OR MILLIMETERS.
2. DIVIDE BY THE REDUCTION RATIO OF THE MACHINE.
3. COMPARE TO SPECIFICATIONS.

FOR EXAMPLE: $X = 4.11$ IN.

$Y = 54.5$ MM

ASSUME A REDUCTION RATIO OF 23X

$$\frac{4.1}{23} = 0.178 \text{ IN.}$$

$$\frac{54.5}{23} = 2.37 \text{ MM.}$$

SPECIFICATIONS:

LARGE BLIPS: 0.165 TO 0.185 IN. (4.19 TO 4.70 MM)

MEDIUM BLIPS: 0.075 TO 0.095 IN. (1.91 TO 2.41 MM)

SMALL BLIPS: 0.027 TO 0.038 IN. (0.69 TO 0.97 MM)

MINIMUM SPACING: 0.027 IN. (0.69 MM)

MINIMUM HEIGHT FROM FILM EDGE: 0.045 IN. (1.14 MM)

5-2.2. Using the Comparator Kit (78-8032-7548-2)

A Comparator Kit (Eye Loupe) can be used to measure blip width and spacing directly on film as follows:

1. Measure the suspected blips (or spacing) on film as show in Figure 5-2.2A.
2. Compare the measurement with the Specifications given below.

Note

Each graduation on the Comparator Kit "Inch" scale is 0.005 inch. To calculate blip width or spacing, simply count the graduations and multiply by 0.005 inch, as shown in the illustration.

Specifications:

Large Blips: 0.165 to 0.185 IN. (4.19 to 4.70 mm)
 Medium Blips: 0.075 to 0.095 IN. (1.91 to 2.41 mm)
 Small Blips: 0.027 to 0.038 IN. (0.69 to 0.97 mm)
 Minimum Spacing: 0.027 IN. (0.69 mm)
 Minimum Height from film edge: 0.045 IN. (1.14 mm)

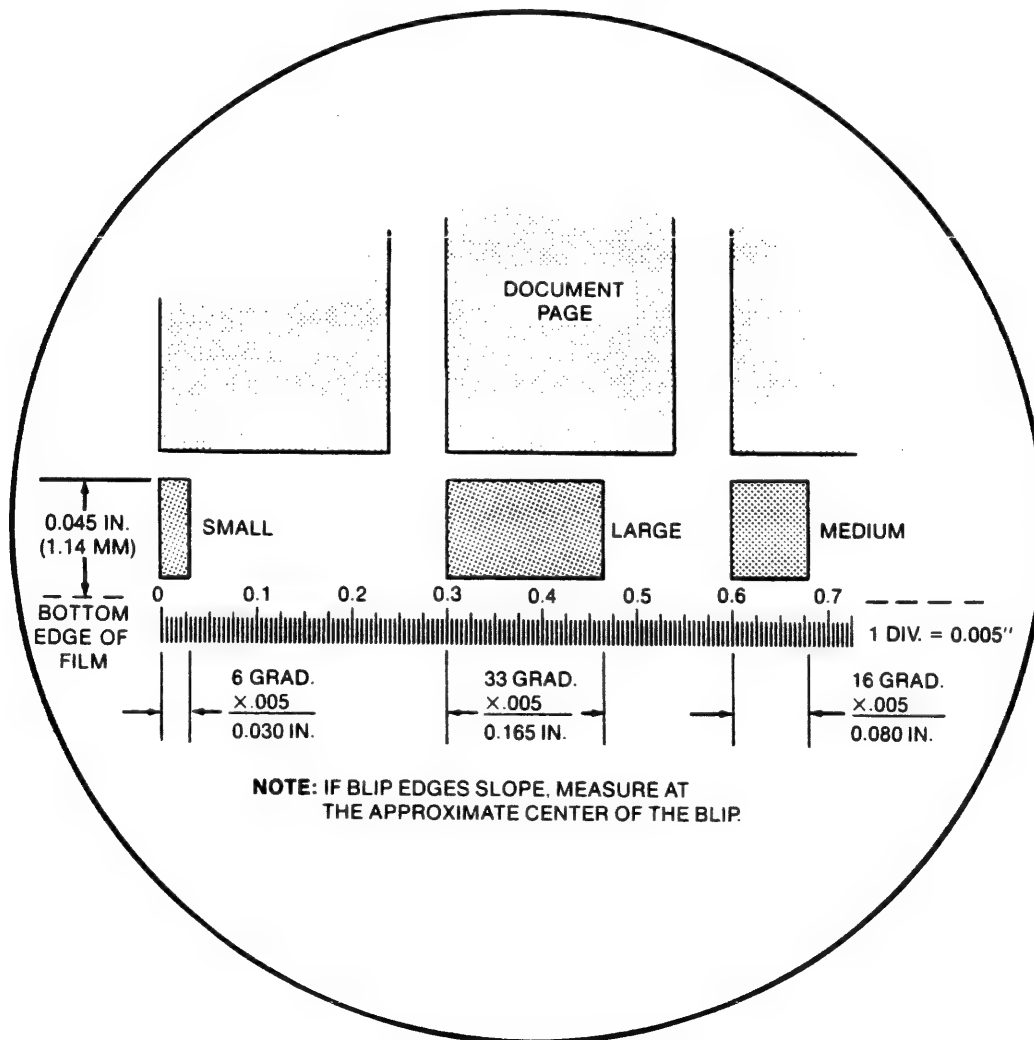


Figure 5-2.2A

5-3. Film Control--What Is It?

Various 3M page search machines can now read and interpret coded data placed in the blip channel of microfilm by the camera. Two types of the "film control code" exist: Image Management Code (IMC), produced by Kodak microfilm cameras, and 3M Control Code (3MC), produced by the 3M M-684 Camera. the purpose of these codes is essentially the same--to set up page search reader-printers for more automated searching on the roll of film containing the code. Although the

essential information conveyed in the two types of code is similar, the coding systems are very different, so the page search software requires two different programs to interpret the two codes. The page search recognizes which type of control code is on film by measuring the length and spacing of the start codes preceding the coded data. IMC uses 0.750 inch (19 mm) start codes, while 3MC uses 0.36 (9.2 mm) start codes. As shown in Figures 1 and 2 below, film control code data is located in "blocks" on the film, enclosed by start and stop codes.

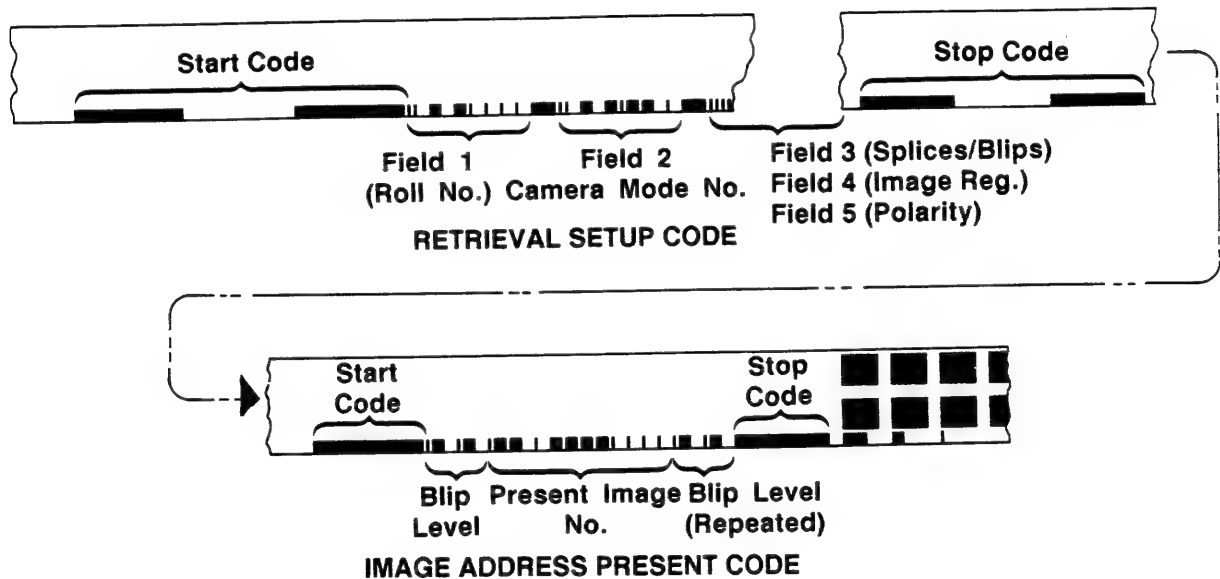


Figure 1. IMC Film Control Code

Film Control Code -- What Is It? (Cont.)

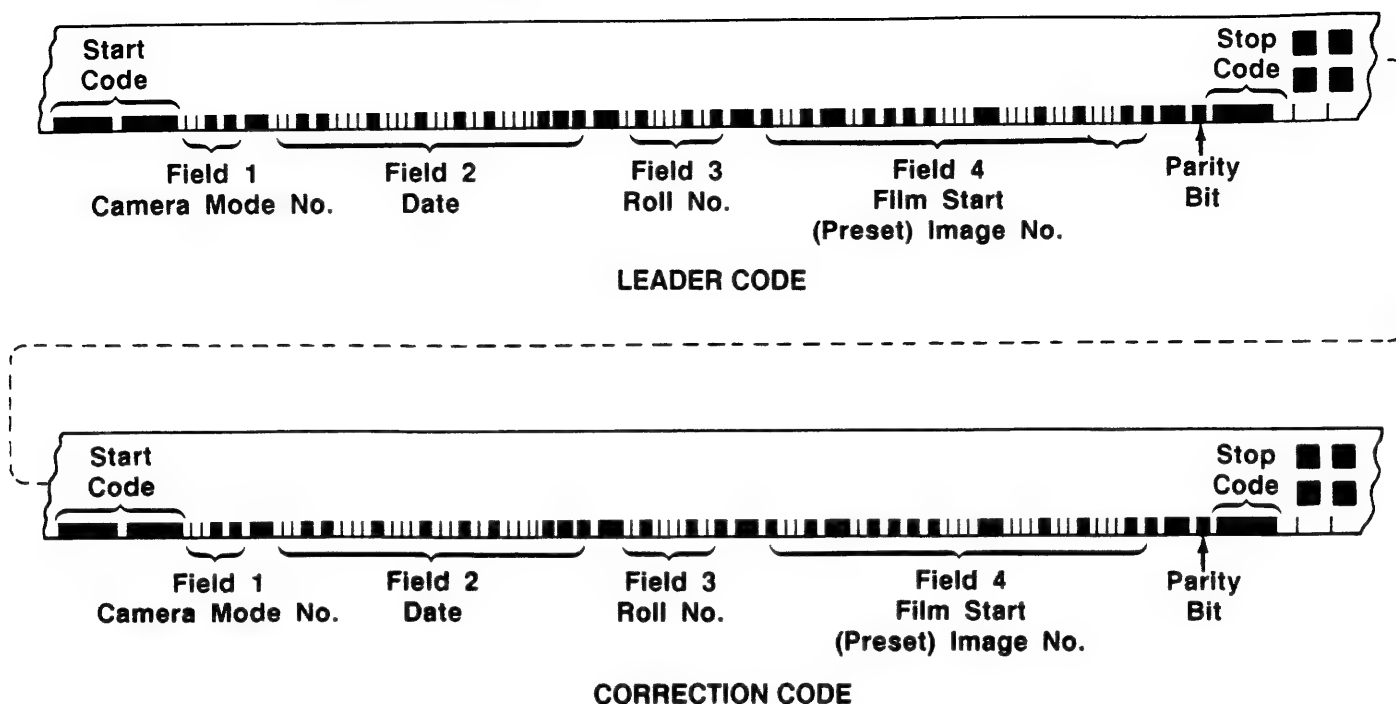


Figure 2. 3MC Film Control Code

IMC includes two kinds of code, both found at the leader end of the film:

- **Retrieval Setup Code** --This includes the following data: film roll number (i.e., cartridge number) and camera filming mode number. It provides also certain parameters that 3M page search machines do not use. These relate to such information as film splicing, image registration, and blip polarity.
- **Image Address Preset Code** --This block of coding follows the Retrieval Setup Code on the leader end of the film, but may also be used elsewhere on the film. The code includes an image address which the page search uses to preset its film counters to the correct starting value for the following images on film. Note that the

data includes a blip level value (Block, Batch, or Item). Each block of Image Address Preset Code can contain the address of only one blip level. Thus, to provide a full three-level address (Block, Batch, and Item), three blocks of code must be included on film.

3MC also includes two kinds of code:

- **Leader Code** --This includes all the essential data included in the two kinds of IMC code read by 3M page search machines: camera filming mode number, film roll number, and image address preset code. The leader code also provides date of filming information, which is not used by the page search machines.

Film Control Code -- What Is It? (Cont.)

- Correction Code--This code is placed by the camera anywhere on film that an error occurred during exposure. The purpose of the code is to reset the blip count if an error requires that a frame be re-exposed on the film. The essential information provided in the code is the film restart image number. The code includes the following data that 3M page search machines do not use: filming date and an error code.

As indicated above, film control code contains certain data items that 3M page search machines read, but do nothing with. The only information in either type of control code that 3M page search machines act upon is the following:

- Microfilm Roll Number--This number is used by the page search machine only if a cartridge number has been stored for use in a Memory Register--either via a download in an API or BPI/host computer setup or by means of the keyboard. Whenever a search or printing operation involves the Memory Registers, the page search firmware will compare the cartridge number in the register to the control code number. If the two numbers do not agree, the firmware will generate error code 220.

Note

This roll number comparison can be disabled by the service technician.

If no cartridge number is stored in the Memory Registers, the cartridge number coded on film is read by the page search, but ignored, because there is no number to compare it with. (To refresh your memory on Memory Register operations, reference the exercise on page 5-.

- Camera Filming Mode Number--This number must be translated by firmware in the page search machine to the appropriate reader-printer search mode number, thus automatically setting the reader-printer to use the correct search mode for the current roll of film. If the page search firmware cannot find a mode in its translation table that corresponds with the camera mode, it will generate error code 221.

This error code will also occur if the machine misreads the code and gets an invalid mode number.

Note

The reader-printer control program can be set to ignore the mode data in the control code, by means of parameter 113.

This feature will not be effective if the code is not read by the machine before a search number is keyed in. (Normally it will not be read during film load.) If the keyed address is in a different mode from the current machine mode, an error (such as "too many digits") will occur. In some cases, the mode must be set either from the keyboard or by manually driving the code area of the film through the page search sensors before entering the search number.

- Starting (or Re-starting) Image Address--This number in the control code is used by the page search reader-printer to set its blip counters to the correct starting address for the following blips on the roll of film. It is used at the beginning of the roll to "preset" the correct address, and it is used elsewhere on the film to reset the blip count if a filming error has occurred, if there is a change in the series of document numbers, or if a series of documents has to be refilmed. Examples of the latter two cases follow:

- **Example 1. Change in Number Series.** Assume that a roll of film includes image numbers 1 through 1000, and that for whatever reason, this series is discontinued and other batch is filmed, numbered 6001 through 8000. Between images 1000 and 6001 a code sequence must be filmed to reset the machine count from 1000 to 6000 so that the reader-printer will begin to count the blips in the second batch beginning with 6001.
- **Example 2. Refilming a Batch.** Assume that Batches 1000 through 1200 have been filmed, but for some reason Batch 1154 has to be refilmed. At the end of Batch 1200 a code sequence must be filmed to reset the count to 1153. Then Batch 1154 can be refilmed. At the end

Film Control Code -- What Is It? (Cont.)

of new Batch 1154 another code sequence must be filmed to reset the count back to 1200.

Thus when Batch 1201 is later filmed the count will be correct and will increment in normal fashion. However, the obvious problem remains that the roll of film contains two batches in two different locations on film, both identified by the number 1154. In a host computer setup the index processing software can alert the operator that the batch has been refilmed. When the operator searches for batch 1154, the unit will stop at the first filmed batch. The operator can then press B RUN, and the unit will search to the correct (second) Batch 1154.

What 3M Page Search Machines Can Read Control Code?

- 7510 Page Search -- The 7510 has the capability of reading both IMC and 3M codes. However, when reading 3M code, some counting problems have occurred in the field relating to the reading of Correction Code. These problems have been corrected with the release of firmware revision level 5.11.

Note

The same problems have occurred in the following machines identified as having 3MC capability. These problems will also be corrected with software revisions.

- 597 -- The standard 597 can read only IMC code. However, installation of the LED Micro Kit (78-8049-2683-6) enables it to read 3MC also. Note that the LED Micro Kit is a charge item.
- 7530 and 7540 with 656 -- Early 7530s could read IMC only. Currently, 7530s and 7540s operating with software version 2.00 and higher can read both IMC 3MC.
- 598 -- The 598 page search can read neither IMC nor 3MC (nor can any of the earlier 3M page search machines).

How Do You Activate a Machine to Read Control Code?

If the customer's film contains control code, the page search machine **must** be activated to read it, or the page search software will simply read the control codes as image blips. This will obviously result in counting errors. The fact that control code sequences may be located within the film as well as at the beginning compounds the possibility of counting problems. The procedure for activating film control code reading is the same for both types of control code.

To Enable Film Control Code Reading in Your Page Search Machine:

1. Set the Write Line Disable Switch DOWN. (This switch must be down whenever you are changing Micro PCB parameters.)
2. If you wish to enable all search modes (1-18) to read control code (with roll number comparison), enter **3597 L 8026 L**. This will enter a Mode Parameter value of 24 for all page search modes (see Table 2-2 Mode Parameters, page 2-18 of the M-656 Page Search Installation Instructions).

CAUTION

Using 8026 L can cause problems if individual Mode Parameters are currently set (or will have to be set). The 8026 command will add a value of 24 to the value set for any individual parameter. Do not use 8026 if you have to set individual parameters as described in step 3 following.

3. If you wish to enable control code reading only in certain search modes, if you wish to suppress roll number comparison during control code reading, or if you wish to enable other Mode Parameter features, you must set up Mode Parameters for individual search modes as follows:
 - a. Enter **3597 L 7000 L** to gain access to the EEPROM parameters.

- b. Refer to Table 2-1 EEPROM Parameters, page 2-18 of the M-656 Page Search Installation Instructions. At the keyboard, enter the "Mode Parameters" number from the table for the page search mode applicable to the control code film. For example, for Mode 12, enter the number 285. The value stored at this parameter location will display.
 - c. Refer to Table 2-2 Mode Parameter, page 2-23 of the M-656 Page Search Installation Instructions.
 - d. Press B. Then enter the four-digit input value from Table 202 that will enable film control code reading.
- For film control reading without roll number comparison, enter **0008**.
 - For film control reading with roll number comparison, enter **0024**.
 - If you wish to select other mode parameters along with "film control code reading" (e.g., "setting blip polarity" or "duplex printing"), use the appropriate four-digit input value to select the desired combination of parameters.
 - e. After entering the new parameter value, press **STOR**.
4. Check, and if necessary, set the following parameters to the indicated values (if necessary, refer to Table 2-1 EEPROM Parameters, page 2-18 of the M-656 Page Search Installation Instructions for the procedures to examine and change parameters):
 - For 3MC, 654 should be set to **0001**.
 - For 3MC, 655 should be set to **0001**.
 - For 3MC, 656 should be set to **0006**.

These are mode number conversion parameters for 3MC code.

5. After setting any parameters, make sure the changed parameter values are recorded on the Parameter Card located in the rear of the Flip Chart on the machine.
6. After completing the activation procedure (step 2 or 3 and 4 and 5 above), set the Write Line Disable Switch UP.
7. Power OFF. Wait 1 second, then power ON.

Some Key Points to Keep in Mind When Working with Film Containing Control Code

- Black or reflective splicing tabs on the film in some cases are causing problems in reading IMC code. The reason for this is that the start code for IMC is nearly the same size as the splicing tabs. The problem occurs if the splicing tab just precedes the film code (usually at the beginning of the film). Recommend to the customer the use of clear tabs, if you experience this problem.
- Batch Printing Problem. With the current software in the field, loss of the print count can occur on occasion when the machine encounters film control code as it is stepping backward through a batch on film. The batch will print, but the print count will be lost and therefore the next search cannot be generated. If this occurs, the operator should reset the blip count before searching again.
- Image Address Preset Code Must be Located at the Beginning of Film. If the camera does not place a preset code at the beginning of the film (even if the first blip is a "1" count), the page search may lose count and rewind the film during reverse searches on film that contains correction code. Operation in the forward direction will not be a problem.

- Search Mode Changes Caused by Film Control Code. Keep in mind that the machine search mode can be changed by a film control code sequence located anywhere on film. The operator, for example, can set the machine to a 2-level mode at the keyboard, and then become confused if the control code changes the mode to 3-level. Confusion can also result if film of one mode is spliced onto a roll containing documents filmed in a different mode.
- How to Tell if Film Control Code is Being Read by the Page Search. 3M page search machines automatically load film, but do not advance it to documents (unless the operator "keyed ahead" before loading the cartridge). The film control code will not be read until a search is keyed in or the SEARCH knob is turned to advance the film. You can tell that the code is being read when the display count jumps from zero to the present number contained in the control code (unless the preset number is "1"). You can also stop the film and press the MOD key to check whether the control code has changed the search mode. Control code films often have the image number right on the film. This may help you determine if the machine read the code correctly or if the code was filmed incorrectly.
- Using the B RUN Command. The use of "correction" code on film to correct a filming problem and reset the count occasionally results in an error message during search (CHECK FOR INDEX ERROR, #0024). When this occurs, the operator should key in B RUN to continue the search for the requested document. If it is located further down toward the trailer end of the film, the machine will retrieve it. If end of film is reached before the document is retrieved, the operator should rewind the film and search from the beginning. If the count is reset frequently on a particular roll of film via correction code, the searching sequence can become confusing. The following general rules may help to clarify things:

1. The page search software will initiate a search backward on film if the number keyed in is smaller than the number currently displayed.
2. The machine will search forward, even past larger numbers than those entered at the keyboard, until the desired document is retrieved or until end of film is reached. When end of film is reached, the film should be rewound in order to search again.

As illustrations of these two rules, let us consider two examples:

Example 1. Assume that the film is halted at batch 100 on the film shown below in Figure 3, and the operator keys in a request to search to batch 300. The machine will search down the film past reset numbers 800 and 900, and retrieve batch 300.

Example 2. Assume for this example that the film is halted at batch 100 on a different roll of film (Figure 4). Again the operator keys in a request to search to batch 300. On this roll of film, however, batch 300 is located ahead of the currently displayed batch 100. The machine will search forward toward the end of the film. (It will not drive in reverse toward 300, since the entered number is larger than the current number.) When the end of the film is reached, the film will halt and the message CHECK FOR INDEX ERROR (Error Code 24) will display. The operator must clear the message and rewind the film, then reload and enter a request to search to 300.

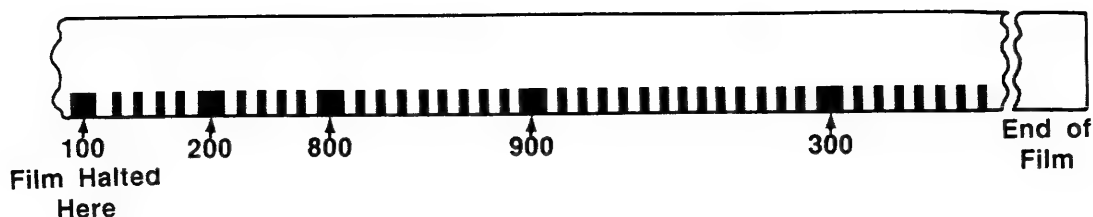


Figure 3

Availability of Reader-Printer Communications Diagnostic Diskette

A Reader-Printer Communications Diagnostics Diskette package (78-6969-6242-8) is now available from SPC. The package provides diagnostics on both 3-1/2 inch and 5-1/4 inch diskettes, and includes instructions for using the diskettes. The diagnostics can be run in FileSaver, MIRS, or WorkManager systems that include the following page search Reader-Printers: 597, 598, 7510, or 7530/40 with 656.

The diskettes can check communications between a PC serial port and a reader-printer either before or after the software (FileSaver, MIRS, or WorkManager) is installed, and provide diagnostic routines for all three types of software. The diagnostics can:

- Test the PC serial ports.
- Test the reader-printer in various download modes.
- Set the reader-printer API parameters.
- Test the enabler used for security in FileSaver systems.

Use of the diagnostics is simple and straightforward. They are not designed to replace existing service documentation, but to serve as an extension of the documentation. We recommend that all technicians servicing the systems identified above have a diagnostic diskette in their custody.

Note

In the installation of FileSaver, MIRS, or WorkManager systems, the service technician can use a diagnostic diskette to check communication between the PC and the reader-printer after installing the hardware. Be aware that the policy regarding installation of software for the FileSaver and MIRS systems has changed. The technician **should not** install software for these two systems. A sales Field Support Specialist (formerly called "CAR Rep") will install the software and train the customer.

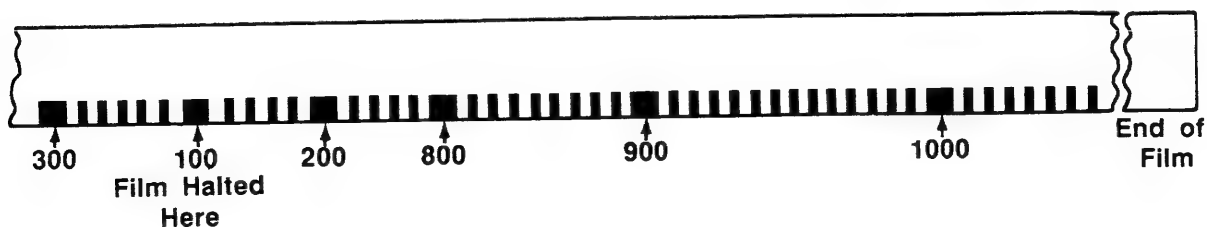


Figure 4

5-4. Memory Register/Autoprinting Exercise

As an illustration of the functions of the Memory Registers and Autoprinting, perform the following exercise, using a typical roll of film. The procedure assumes the use of single-level blipped film (one blip size). If you wish, you may use any other type of blipped film. (The frame number keying sequences, however, will vary for different level films, as explained in Section 3-5 Search Sequence, page 3-12 of the MFB 100 and M-7540 MFB Reader-Printers with Page Search Operating Instructions and following:

1. Set the Search Mode to 1, to use single-level blipped film (see page 5-3 of the MFB 100 and M-7540 MFB Reader-Printers with Page Search Operating Instructions).
2. Load several Memory Registers, as follows:
 - Key in **1 SET STOR** (to access Memory Register 1).
 - Enter **5 CART STOR** (to store Cartridge Number 5 in Register 1).
 - Enter **6 STOR** (to store Frame Number 6 in Register 2).
 - Enter **8 STOR** (to store Frame Number 8 in Register 3).
 - Enter **10 STOR** (to store Frame Number 10 in Register 4).
 - Enter **12 STOR** (to store Frame Number 12 in Register 5).
3. The first five memory Registers are now loaded with the following numbers, in order: Cartridge 5, Frame 6, Frame 8, Frame 10, and Frame 12. You can examine the contents of any register by accessing the register (**1 SET STOR**), for example, and then entering **MOD STOR**. Autoprint from the loaded Registers as follows:
 - Enter **MOD AUTOPRNT** (to request prints of all frames stored in the Memory Registers). The film will rewind and **CART 5** will display. This is a request for you to load Cartridge 5 in the machine.
 - Load a single-level cartridge. (For the purpose of this exercise, any cartridge number will do.) The Autoprint sequence will step the film to Frames 6, 8, 10, and 12.

Check the System Mode

1. To check the current machine mode, press **MOD**, (the number of the current mode will display).
2. To change the current machine mode, press **CLR**, enter the number (1 through 18) of the desired mode, and press **MOD**.

5-5. Software Support Center

There is now a Software Support Center located in St. Paul. If you are at an account and require some assistance relating to a Reader-Printer installed in a system with 3M software, you can call **612/736-8091**.

When you call this phone number, be prepared to identify the 3M software and the host system by name. The software packages supported at this time are the following:

- FileSaver
- WorkManager
- DMS (Document Management Software) with either a PRIME or IBM host
- Micrapoint

5-6. API/BPI NOVDRAM Settings for 3M Software

1. For FileSaver: Use **34 L** (CAR Mode) for the parameter default settings.
2. For WorkManager: Use **33 L** (3M Download Mode) or **36 L** (3M Enhanced Download Mode) for parameter default settings. Then change the Baud rate to 9600, change the number of Start Characters to five, and change the Start Characters to those shown in the table below, depending on the number of the Reader-Printer in the system.
3. DMS on PRIME: Use **32 L** (3M Enhanced Download Mode) for parameter default settings. NOTE: Some older IBM DMS installations may use a mode other than 3M Enhanced Download.

WorkManager Work Stations for Start Characters

Reader-Printer Work Station No.	Start Character	Hex Value
1	<	3C
2	[5B
3]	5D
4	{	7B
5	}	7D
6	=	3D
7	\	5C
8	:	7C
9	Z	5A
10	Q	51
11	W	57
12	U	55

Problem Notes

In the following applications, the M-656 API Firmware should be at version 1.12 or higher:

- Micrapoint Remote Terminal
- DMS PRIME
- UniSearch (from COM Squared)
- Any Direct Search (Micrapoint) Mode on-line application with a Baud rate above 1200

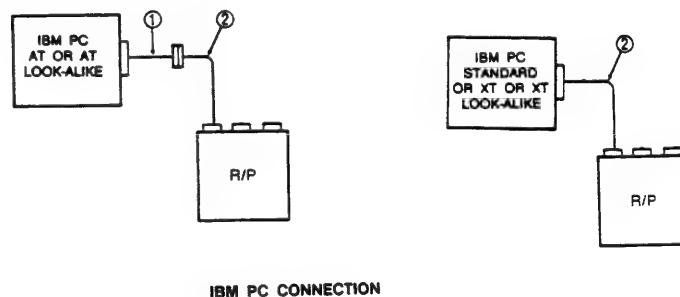
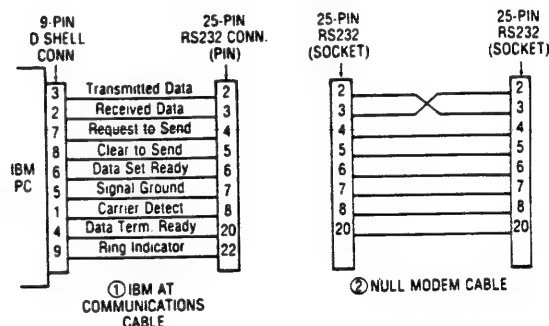
With API firmware versions earlier than 1.12, the Reader-Printer must be turned off, then on, after each search to ensure that the next command search will work.

To check the API/BPI firmware level, key in 3597 L 8888 L 55 L. The Display will show a three-digit number corresponding to the firmware level. For example, 205 = 2.05 level. The current production levels for both API and BPI are 2.05. However, later versions with feature enhancements and subtle problem corrections are being field tested.

5-7. Cabling Notes

The illustration below details connection of a Reader-Printer to a host IBM PC (or Look-alike). All 3M Reader-Printers connect to a host identically:

- Received Data is on pin 3
 - Signal ground is on pin 7
- The API will generate a Data Terminal Ready (DTR) signal if the host requires it on pin 20. To generate this signal you must set DIP Switches 1, 2, and 4 on the API PCB to the "on" position. **NOTE:** The DTR signal is not required for any of the 3M software installations. It must be OFF in DMS PRIME and Micrapoint Remote Terminal applications or it will interfere with communication between the host and the terminal.



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6-1. PAGE SEARCH SYSTEM OVERVIEW

The combination of M-7530 Reader-Printer, M-654 Cartridge ANSI Transport, and M-656 Page Search Module composes a microfilm page search system. Film is driven during search by the M-654 mounted on the M-7530. The M-656 counts blips to retrieve the desired image. After the image is retrieved, it is displayed on the viewing screen of the M-7530, and if a plain paper print is desired, it can be produced by the M-7530.

Each unit in the three-module system (Reader-Printer, Cartridge ANSI Transport and Page Search) has its own microprocessor control system. The M-7530 and the M-654 can function together as a self-contained system, without the page search function. However, when the M-656 is added to the system, the controls and digital displays of the other two modules (M-7530 and M-654) are disabled. The search and print functions are controlled by the operator from the M-656 keyboard. Interfacing functions between the three machines are described in the next paragraph.

6-2. COMPONENT DESCRIPTION

Asynchronous Protocol Interface (API) PWA-- Adapts the Page Search System to operate under the control of a host computer. Can operate under 3M Micrapoint and CAR systems or under the control of Prime or IBM personal computers using 3M Document Management System (DMS) software, or 3M Filesaver and Workmanager systems. Working with appropriate applications software, the host computer can automate the following microfilm retrieval functions:

- Downloading of microfilm Cartridge and Image Numbers into registers in the M-656 for subsequent search on microfilm.
- Direct search on microfilm, with the Page Search system under control of the host computer.

Backplane PWA--Provides a means of interfacing the M-7530/7540, M-654, M-656, and host computers. Serves also as a bus between the Page Search PWA, Micro Interface PWA, Interface PWA, LED Micro PWA, Photo Sense Amplifier PWA, and LED Keyboard/Display PWA.

Bi-Phase Protocol Interface (BPI) PWA--Adapts the Page Search System to operate under the control of a host computer. Can operate under various IBM computers using 3M Document Management System (DMS) software. Working with the appropriate applications software, the host computer can automate the following microfilm retrieval functions:

- Downloading of microfilm Cartridge and Image Numbers into registers in the M-656 for subsequent search on microfilm.
- Direct search on microfilm, with the Page Search system under control of the host computer.

Blip Sensors--Two pairs of photosensors that react to light projected from the Blip Lamps. The sensors in each pair are designated Right and Left and are placed sequentially so a blip passes beneath one and then the other. The order in which the sensors are activated indicates to the Page Search logic which way the film is moving. The sensors react to dark blips on positive film and light blips on negative film. The change in voltage level is what triggers a count, not whether the pulse is positive or negative. See Adjustment 3-2 Blip Sensor Assembly Position, page 3-1; 3-5 Blip Sensor Position, page 3-7; and 3-6 Blip Photo Sensor Gain, page 3-9.

Blip Sensor Lamps--Powered by 2.5 vdc from the Photo Sense Amplifier PWA and eventually from the 5 vdc from the Power Supply. Two lamp assemblies are mounted beneath the film plane and under the A Row and B Row photodiode assemblies. These transmit light through the film up to the A Row and B Row photodiode sensors. This light triggers the sensors to count blips during film search. The blips may be either opaque (on clear film) or clear (on opaque film). In either case, the sensors are triggered by a change in the intensity of the transmitted light as the blips pass between the lamp and the photodiodes above. Light striking a photodiode through a clear area on the film causes it to conduct, producing a low-level positive dc output. When opaque areas on the film block the light sufficiently to cut off conduction, the diode output is 0 volts. The sequence in which the photodiodes are activated--left to right or right to left--indicates to the page search logic the direction of film travel.

Digital Display--Monitors input from the Keyboard and displays various other data.

EEPROM--Electrically Erasable programmable Read Only Memory which can be used by the technician to store program modifying parameters. For example, data can be input from the Keyboard to customize the software to run searches on film that contains blips of non-standard size.

Fan--Mounted on the Rear Door of the Page Search Module to dissipate heat generated by the Power Supply and other PCBs mounted on the Card Cage. Runs on -24 vdc and protected by a 1 Amp Fuse (F2).

Film Sensor (S6)--Reflective photosensor that indicates the presence of film in the threading path of the Blip Sensor Assembly. The dull side of exposed silver halide film is the worst case for sensing. See Adjustment 3-3. Film Sensor (S6), page 3-3.

Jumper PWA--Parallel bus printed wiring assemblies connecting the Micro Interface PWA with the Page Search PWA and M-656 Interface PWA.

Keyboard--Consists of two keypads, Print Key, and Digital Display to communicate with the Page Search data retrieval system and control its various operations. The larger keypad on the left side of the keyboard contains the general function keys used to control the standard page search operations. The smaller keypad on the right side of the keyboard is used to perform special functions. The operator enters search input and print commands or can change the many system parameters to match the characteristics of different microfilm storage formats. The technician can also use the Keyboard for diagnostic command input.

Key Matrix--Initiates electronic signal that record the location and order of keystrokes as the operator presses keys on the Keyboard. Upon receiving the location code of a keystroke, the Microprocessor uses its primary "look-up" table to determine the meaning of that key. See page 5-5.

Lamp Filter--A green tinted glass filter to allow detection of Diazo film.

LED Micro PWA--Controls the Digital Display from keystrokes from the Keyboard.

M-656 Interface PWA--Sends and receives signals from the M-7530/7540 and M-654.

Micro Cage--Electronics rack within the Workstation that provides a stable mounting for the Page Search PWA, Micro PWA, two Jumper PWAs, Backplane PWA, and optional Asynchronous Protocol Interface (API) PWA or Bi-Phase Protocol Interface (BPI) PWA.

Micro-Interface PWA--Contains the I/O Ports which allow the Microprocessor to communicate with the other PWAs in the Card Cage via the Micro-System 8-bit bus. Each I/O chip contains three 8-bit ports. Each bit is either a command line output (from the micro system) or a sense line input (to the micro). In the diagnostic mode, the service technician can use the Keyboard to activate a selected command line or monitor a selected sense line via the Keyboard Display. Note on the M-656 System Functional Diagram that only five of the six I/O Ports Chips on the PWA are used.

Micro PWA--Control center for all Page Search functions. Major functional components are the:

- 8086 Microprocessor, which runs the page search control program.
- 48 kbytes of PROM (Programmable Read-Only Memory), which contains the page search program software.
- 4 kbytes of RAM (Random Access Memory), which provides temporary storage for manipulation of data by the microprocessor.
- 2 kbytes of EEPROM (Electrically Erasable Programmable Read-Only Memory), which can be used by the technician to store program modifying parameters. For example, data can be input from the m-656 keyboard to customize the software to run searches on film that contains blips of nonstandard size.
- Keyboard/Display Interface Chip, which enables the M-656 Keyboard and Display to communicate with the microprocessor.

Microprocessor--Runs the Page Search program. This PWA contains drivers which match the logic circuits in the M-656 with the circuits in the M-654 and M-7530/7540 which either send or receive interfacing signals. In addition, the PWA includes a Divide-by-400 Counter. This counter produces an Odometer Interrupt for every inch of film travel. This signal is sent to the micro to be used in the process of stopping transport drive at the end of film. When blip pulses are no longer being received by the micro, it allows the film to travel a short distance before stopping drive. This distance is measured by the Odometer Interrupt pulses.

Micro-System Bus--Each I/O chip contains three 8-bit ports. Each bit is either command line output from the Microprocessor, or a sense line input to the Microprocessor. In the Diagnostics Mode, the technician can use the Keyboard to activate a selected command, or monitor a selected sense line, via the Digital Display.

Page Search PWA--Receives and processes the blip count signals from the Photo Sense Amplifier PWA. Essentially, it compares the odometer count (distance on film) with the length of the received blip pulses to determine the size of the received blips. It also compares the sequence in which the left and right pulses are received to determine the direction of film travel. It passes this data along with the number of blips of each size to the micro system. The page search software, working in Micro PWA RAM, uses this data to maintain an accurate blip count during search.

Photo Sense Amplifier PWA--Positioned under the Bottom Cover of the M-654 during page Search installation. Receives the signals from the Blip Sensors, adjusts the signal level (gain), and passes the sensed blip signals through amplifiers to the Page Search PWA.

Power Switch--Switches power to the M-656 Page Search ON ("1") or OFF ("2").

Power Supply PWA--Unlike the M-654, the M-656 has its own AC power source independent of the M-7530/7540. The M-656 plugs into a wall outlet and filters the line voltage through a Line Filter. A Jumper on the Power Supply PWA must be cut if the line voltage is

between 190 and 270 VAC. The Power Supply is protected by a 5 Amp Fuse (F1). The Power Supply converts the line voltage into three voltage outputs:

- + 5 vdc supplied to the Backplane PWA required by the Microprocessor and most of the logic circuits. Also goes to a Regulator on the Photo Sense Amplifier PWA which supplies + 2.5 vdc to the Blip Sensor Lamps. Protected by a 4 Amp Fuse (F1).
- + 24 vdc provided to the Op Amps And comparators and to another pair of Voltage Regulators on the Page Search PWA. These regulators supply + 12 vdc for the Op Amps and Comparators. These in turn supply + 5 vdc to the Blip Amplifier Circuits on the Photo Sense Amplifier PWA. Protected by a 1 Amp Fuse (F3).
- -24 vdc provided to the Op Amps And comparators and to another pair of Voltage Regulators on the Page Search PWA. These regulators in turn supply -5 vdc to the Blip Amplifier Circuits on the Photo Sense Amplifier PWA. Protected by a 1 Amp Fuse (F2).

PROM--Programmable Read Only Memory contains the Page Search program software.

RAM--Random Access Memory (Read and write memory) provides temporary storage for manipulation of data by the Microprocessor.

Sensor Window--Helps to keep dust and grime from Lamp filter and Blip Sensor Lamps.

Workstation--Custom designed to accommodate the M-7530/7540, M-654, and M-656 Page Search data retrieval system. Consists of a base cabinet which houses the electronic components of the M-656. Two optional Arms (work surfaces) provide a working surface for the Keyboard, writing material, film cartridges, etc.

Write/Disable Switch--Set in the Disable (up) position, opens the Write Enable Line from the Microprocessor to the EEPROM. Thus, noise spikes cannot affect the values in the EEPROM. Set in the Write (down) position, closes the Write Enable Line to change or reset parameters. The switch should be set to Disable (up) for normal operation.

Failure to do so will allow electrical noise at power up or during operation to change parameter values in the EEPROM.

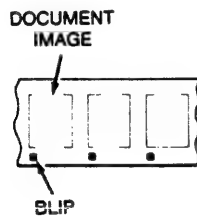
Note

When the switch is open (up), the operator cannot use the 5597 diagnostic entry code to change any of the operator-accessible parameters. (See page 6-23 in the MFB 1100 and M-7540 MFB Reader-Printers with Page Search Operating Instructions.)

6-3. MICROFILM BLIP AND SEARCH TECHNIQUES

6-3.1. Blips (Image Counting Marks)

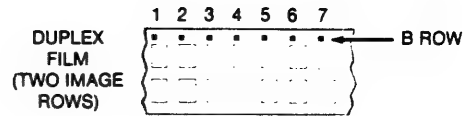
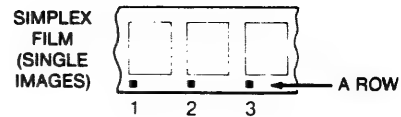
Page Search Reader-Printers search for documents on 16 mm microfilm by counting small marks on the film, called blips.



The blips are exposed on the film, one adjacent to each image, by the microfilm camera when the images are filmed. As the Reader-Printer scans the film during search, it counts the blips until it reaches the number of the desired document. The cumulative count identifies the location of particular images on film, and each image on film can be identified by an image number. Thus the microfilm cartridge (or roll) number and the image number can be used to locate any image in a 16 mm microfilm library.

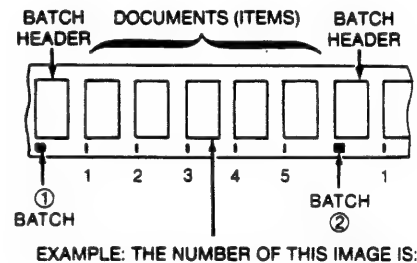
6-3.2 Single-Level Blipping

Film can be blip-encoded in a variety of ways. The simplest method, illustrated below, uses blips of only one size, and thus is called "single-level" blipping. The blips are placed in channels, or rows, on one or both edges of the film. These rows are identified as the A and B Rows.



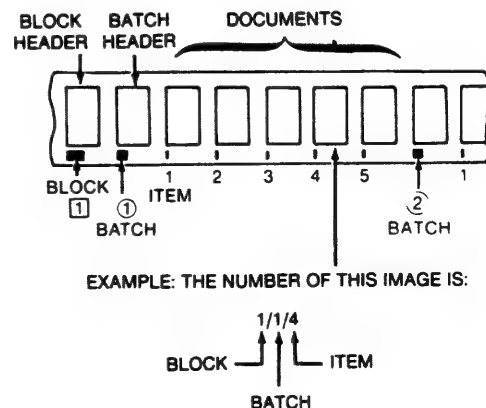
6-3.3. Two-Level Blipping

Two-level blipped film contains blips of two different sizes: medium and small. The medium size blips, called Batch blips, are used to signal the beginning of a batch of Item, or small blips, as shown below.



6-3.4. Three-Level Blipping

Three-level film contains blips of three different sizes: large, medium, and small. The large blips, called Block blips, indicate that following blips are grouped into Batches of Item blips, as shown below.



6-3.5. Page Search Modes

The 656 has the capability of searching on film that is blip-encoded in a great number of formats, but it must be set up in the appropriate page search mode.

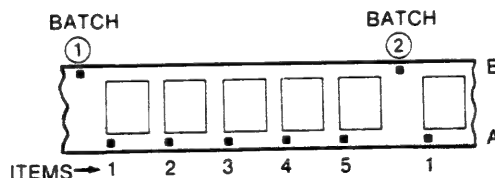
The operator can key in the mode at the 656 Keyboard, or a Host Computer can communicate the mode in a download data string, if the page search system has an API or BPI kit installed. Valid modes are described as follows:

SEARCH MODE	CHARACTERISTICS	FWD ← → REV
1	<ul style="list-style-type: none"> Blips in A row only. 	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>SIMPLEX</p> <p>ITEMS → 1 2 3</p> </div> <div style="text-align: center;"> <p>DUPLEX</p> <p>1 2 3 4 ← A ROW</p> </div> </div>
2	<ul style="list-style-type: none"> Blips in A and B rows. Automatic row traverse at end of film, during search. 	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>DUO-SIMPLEX</p> <p>103 102 101 100 1 2 3 4</p> </div> <div style="text-align: center;"> <p>DUO-DUPLEX</p> <p>96 95 94 93 92 91 90 1 2 3 4 5 6 7 B TRAVERSE A</p> </div> </div>
3	<p>Same as Mode 2, except:</p> <ul style="list-style-type: none"> Has capability of automatic slow speed search to one or two frames from current frame. 	
4	<ul style="list-style-type: none"> Blips in B row only. 	<p>1 2 3 4 5 6 7 8 9</p>

BLIP LEVEL 1

The machine does not recognize blip size differences. That is, all blips are counted as Item blips.

- 5
- Blips in A and B rows.
 - No automatic row traverse at end of film.

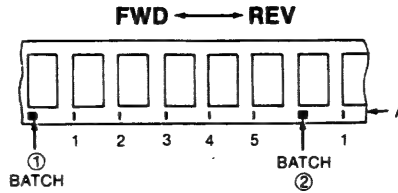
**BLIP LEVEL 1 — BATCH B-A**

To locate a particular frame, B row blips are counted as Batch blips until the desired Batch is located. Then A row blips are counted as Items until the requested frame is retrieved.

**SEARCH
MODE****CHARACTERISTICS**

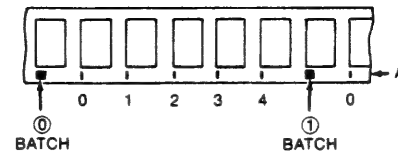
- 6 • Blips in A row only.

- Batch and Item blips begin with 1.



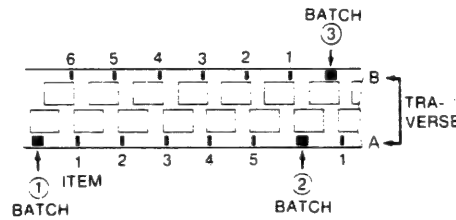
- 7 Same as Mode 6, except:

- Batch and Item blips begin with 0.



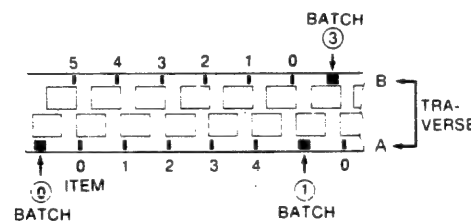
- 8 • Blips in A and B rows.

- Batch and Item blips begin with 1.



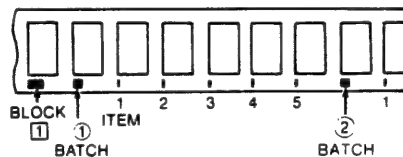
- 9 Same as Mode 8, except:

- Batch and Item blips begin with 0.



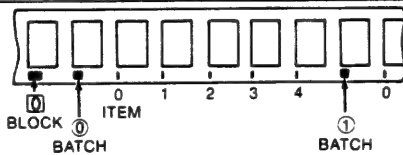
- 10 • Blips in A row only.

- Batch and Item blips begin with 1.



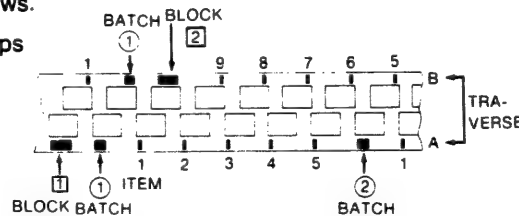
- 11 Same as Mode 10, except:

- Block, Batch, and Item blips begin with 0.



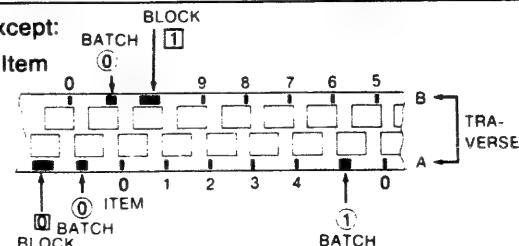
- 12 • Blips in A and B rows.

- Batch and Item blips begin with 1.



- 13 Same as Mode 12, except:

- Block, Batch, and Item blips begin with 0.

**BLIP LEVEL 2**

The machine recognizes two blip sizes: **Batch** (medium) and **Item** (small). To locate a particular frame, medium size blips are counted first to locate a Batch. Then small blips within the Batch are counted to locate the frame.

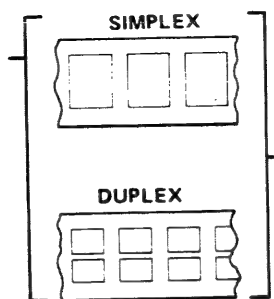
BLIP LEVEL 3

The machine recognizes three blip sizes: **Block** (large), **Batch** (medium) and **Item** (small). To locate a particular frame: Large blips are counted first to locate a Block. Then medium blips are counted within the Block to locate the desired Batch. Finally Item blips are counted within the Batch to locate the desired frame.

**SEARCH
MODE****CHARACTERISTICS**

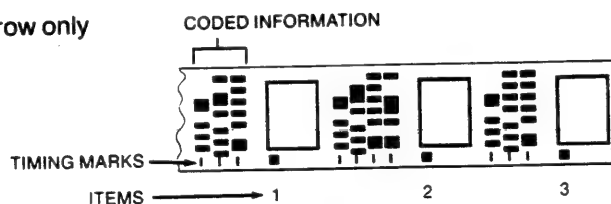
- 14
- No blips.
 - No automatic traverse.

FWD ← → REV

**ODOMETER MODE (NON-BLIPPED FILM)**

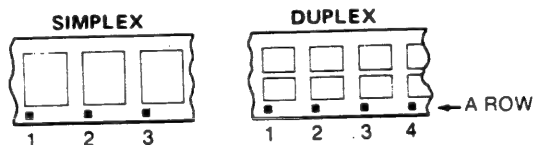
- A number is entered at the Keyboard and search is initiated to drive film until the machine odometer counts up to the entered number.
- Each digit counted represents about 1/2 inch of film. Thus an odometer entry of 2400 will cause film to drive about 100 feet and stop.

- 15
- Blips in A row only

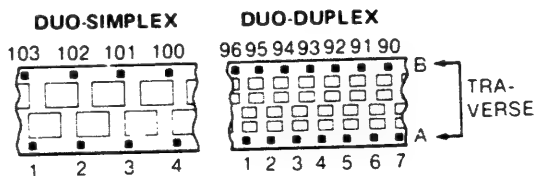
**BLIP LEVEL 1 —
MIRACODE FILM**

- Timing marks are sensed, but not counted as blips.
- Coded information on film is not read.

- 16
- Blips in A row only.



- 17
- Blips in A and B rows.

**BLIP LEVEL 1**

The machine does not recognize blip size differences. That is, all blips are counted as Item blips. Modes 16, 17, and 18 are functionally identical to modes 1, 2, and 3, respectively.

- 18 Same as Mode 17

6-4. SEARCH MODES

6-4.1. Search Mode 1

The M-656 Page Search will count blips in the A Row only. The counting will be ascending when the film is moving forward and descending when the film is moving in the reverse direction.

6-4.2. Search Mode 2

The M-656 Page Search will count blips in the A Row and B Row. The counting in the A Row will be in ascending order when the film is moving forward and in descending order when the film is moving in the reverse direction. The blip counting in the B Row will be in descending order when the film is moving forward and in ascending order when the film is moving in the reverse direction.

6-4.3. Search Mode 3

Search Mode 3 is the same as Search Mode 3 but is compatible with MPI software. The M-656 Page Search will count blips in the A Row and B Row. The counting in the A Row will be in ascending order when the film is moving forward and in descending order when the film is moving in the reverse direction. The blip counting in the B Row will be in descending order when the film is moving forward and in ascending order when the film is moving in the reverse direction.

6-4.4. Search Mode 4

Search Mode 4 is used with Type 3890 Film. The M-656 Page Search will position the document using the edge of the blip opposite that used in other Search Modes. Blip counting in the A Row is ascending order when film is moving forward and descending when the film is moving in the reverse direction. Blip counting in the B Row will be in ascending order when the film is moving forward and in descending order when the film is moving in the reverse direction.

6-4.5. Search Mode 5

Search Mode 5 is not currently used.

6-4.6. Search Mode 6

Search Mode 6 is a one origin mode. The first batch will default to batch one and the first item in each batch will be item 1. Blip sizes are set-up during installation. The M-656 Page Search will count blips in the A Row in ascending order when the film is moving forward and in descending order when the film is moving in the reverse direction. Blips in the B row are ignored. The Page Search can sense two sizes of blips in the A Row and will count batch blips until the batch count is equal to the batch number entered. The Page search will then stop. If no item count is entered, the Page Search will stop on the batch blip when when the batch count is equal to the batch number entered.

6-4.7. Search Mode 7

Search Mode 7 is a zero origin mode. The first batch will default to batch zero and the first item in a batch number is item zero. Blip sizes are set-up during installation. The M-656 Page Search will count blips in the A Row in ascending order when the film is moving forward and in descending order when the film is moving in the reverse direction. Blips in the B Row are ignored. The Page Search can sense two sizes of blips in the A Row and count batch blips until the batch count is equal to the batch number entered. It will then count item blips starting with zero until the item count is equal to the item number entered. The Page Search will then stop searching. If no item count was entered, the Page Search will stop on the batch blip when the batch count is equal to the batch number entered.

6-4.8. Search Mode 8

Search Mode 8 is a one origin mode. The first batch defaults to batch one and the first item in a batch is item 1. Blip sizes are set-up during installation. The M-656 Page Search will count blips in the A Row in ascending order when the film is moving forward and in descending order when the film is moving in the reverse direction. The Page Search will count blips in the B Row in descending order when the film is moving forward and in ascending order when the film is moving in the reverse direction. The Page Search can sense two sizes of blips in either the A Row or B Row. Batch blips will be counted until the batch count is equal to the batch number entered. It will then count item blips starting with one until the item count is equal to the item number entered. The Page Search will then stop. If no item count was entered, the Page Search will stop on the batch blip when the batch count is equal to the batch number entered.

6-4.9. Search Mode 9

Search Mode 9 is a zero origin mode. The first batch will default to batch number zero and the first item in each batch is item zero. Blip sizes are set-up during installation. The Page Search will count blips in the A Row in ascending order when the film is moving forward and in descending order when the film is moving in the reverse direction. The Page Search will be able to sense two sizes of blips in either the A row or B Row. It will count batch blips until the batch count is equal to the batch number entered. It will then count item blips starting with zero until the item count is equal to the item number entered. The Page Search will then stop. If no item count is entered, the Page Search will stop on the batch blip when the batch count is equal to the batch number entered.

6-4.10. Search Mode 10

Search Mode 10 is a one origin mode. The first block will default to block one, the first batch in a block is batch number one, and the first item in a batch is number one. Blip sizes are set-up during installation. The M-656 Page Search will count blips in the A Row in ascending order when film is moving forward and in descending order when the film is moving in the reverse direction. Blips in the B Row are ignored. The Page Search can sense three sizes of blips in the A Row. It will count block blips until the block count is equal to the block number entered. It will then count batch blips starting with one until the batch count is equal to the batch number entered. It will then count item blips starting with one until the item count is equal to the item number entered. The Page Search will then stop. If only a block number is entered, the Page Search will search until the block count is equal to the block number entered and stop on that block. If only a block number and batch number are entered, the Page Search will search until the block and batch counts are equal to the numbers entered and stop on that batch.

6-4.11. Search Mode 11

Search Mode 11 is a zero origin mode. The first block will default to block zero, the first batch in a block is batch zero, and the first item in a batch is item zero. Blip sizes are set-up during installation. The M-656 Page Search will count blips in the A Row in ascending order as film moves forward and in descending order as film moves in the reverse direction. Blips in the B Row are ignored. The Page Search can sense block blips until the block count is equal to the block number entered. It will then count batch blips starting with zero until the batch count is equal to the batch number entered. It will then count item blips starting with zero until the item count is equal to the item number entered and stop. If only a block number is entered, the Page Search will search until the block count is equal to the batch number entered.

6-5. PAGE SEARCH KEYBOARD DESCRIPTION AND KEYBOARD ENTRY

6-5.1. Numeric Keyboard

For modes with only one level of search, the document number is entered from the Numeric Keyboard.

For modes with two levels of search, the keyboard entry procedure is to enter the batch number, then press the A Key which acts as a delimiter, followed by the item number. If no item number is desired (search to a batch only), the A Key and item number are ignored.

For modes having three levels of search, the Numeric Keyboard entry procedure is to enter the block number, then press the A Key, enter the batch number, press A again, and finally the item number. If no item number is desired (search to a block and batch only), the last A Key entry and item number are ignored. For search to a block only, enter the block number and press the A Key.

For all levels of search except Search Mode 14, the maximum allowable frame number is 99999999. The maximum odometer frame count number is 65534.

6-5.2. Run Key

Entering a document number followed by pressing the RUN Key will initiate a search to the document specified. If film was not yet loaded, the search will be remembered and commence after film is loaded. Pressing the CLEAR Key will cancel any remembered search. Pressing the RUN Key with no document number entered causes the film to be rewound.

6-5.3. RSET Key

Entering a document number followed by pressing the RSET Key sets the current document to the number entered.

Pressing the RSET Key with no document number entered causes an Error Code to be shown on the Page Search Keyboard Display.

6-5.4. CLR Key

Pressing the CLR Key clears any number entered. The current document number will be displayed.

Any function currently in process is stopped by the CLR Key including searching, pending print requests, and automatic functions.

6-5.5. A Key

The A Key is used as a delimiter between batches, blocks, and items during multi-level document number entry.

6-5.6. B Key

The B Key is used for multiple keying sequences to help define a requested function.

6-5.7. L Key

When the L Key is preceded by four digits, the four digits are interpreted as an operator command or diagnostic code. The L Key initiates the process and issues an error message if the number was not a valid request.

The L Key is used during multiple keying sequences to help define the requested function.

6-5.8. MODE Key

The MODE Key is used to display or change the current Search Mode. If no document number was previously entered, the MODE Key can be used as a "Shift Key" to access alternate functions of other function keys. Pressing the MODE Key automatically changes the function of other keys if an alternate function exists.

6-5.9. + Key

With no document previously entered, the + Key will advance film one blip regardless of the size of the current or next blip.

When a document number has been previously entered and in a single-level mode, the + Key will add the entered document number to the current number and search to the sum of the two numbers.

When a document number has been previously entered and in a two-level mode, the batch number entered is added to the current batch number and the item number remains the same. Example: Having a current document number of batch 3, item 2, the entry of batch 4, item 9, +, will search to document batch 7, item 9. The exception is when batch zero has been entered. In this case, the item number is added to the item number specified. Example: Having a current document number of batch 3, item 2, the entry of batch 0, item 9, +, will search to document batch 3, item 11.

When a document number has been previously entered and in a three-level mode, the block number entered is added to the current block number and the batch number and item number remain the same. The exception is when the block number or the block number and batch numbers are zero. In this case, the search responds as for two-level film.

In Search Mode 14 with no document number entered, the M-656 Page Search will add two odometer counts to the current count and search to the new count.

6-5.10. - Key

With no document number previously entered, the - Key will move the film one blip in reverse called "decrementing film". In multi-level modes, this decrement is still one blip regardless of the size of the current or previous blip.

When a document number has been previously entered and in a single-level mode, the - Key will subtract the entered document number from the current number and search to the difference of the two numbers.

When a document number has been previously entered and in a two-level mode, the batch number entered is subtracted from the current batch number and the item number remains the same. Example: Having a current document number of batch 7, item 9, the entry of batch 4, item 7, -, will search to document batch 3, item 7. The exception is when batch zero is entered. In this case, the item number is subtracted from the item number entered.

When a document number has been previously entered and in a three-level mode, the block number entered is subtracted from the current block number and the batch number and item number remain the same. The exception is when the block number or the block number and batch numbers are zero in which case the search responds as for two-level film.

In Search Mode 14 and no document number entered, the Page Search will subtract two odometer counts from the current count and search to the new count.

6-5.11. STP Key--unshifted

The **STP** Key allows the Operator to examine documents by stepping to the next frame automatically with a delay between frames. The delay default is one second but can be specified with the **SET** Key. The range of documents to be examined can be bracketed with the **RNGE** Key.

With no document number previously entered, the **STEP** Key will step from frame to frame, block to block, or count to count similar to if the number 1 had been keyed in first. When a document number has been previously entered and in a single-level mode, the **STEP** Key will stop at every "nth" document where "n" is the document number previously entered. Example: If the current document number is 6 and 4 and the **STEP** Key is pressed, the Page Search will step document 10, 14, 18, 22, 26, 30, 34, etc.

When a document number has been previously entered and in a multi-level mode, the **STEP** Key will step every "nth" block if a non-zero block number was keyed in, every "nth" batch if a zero block number was entered, and a non-zero batch number, and every "nth" item if a zero block number and a zero batch number were entered. If item viewing is selected, the Page Search will stop on every block and batch blip crossed. If batch viewing is selected, the Page Search will stop on every block crossed.

The **PRINT** Key may be pressed when the viewing has stopped on a document. The Page Search will then make a print of that document before continuing the step.

6-5.12. STEP Key--shifted

The shifted **STEP** Key can be used to search cartridges and frames specified in the Memory Registers. This process will prompt the Operator to load the specified cartridges and automatically search to the proper frame.

If no previous range has been entered, the Memory Registers, the complete contents of the Memory Registers are searched.

If a range has been previously entered, the Memory registers whose numbers are in that range are searched. Example: If the range has been set to 3-10, then the frames specified in Memory Registers 3-10 are searched.

6-5.13. AUTO PRNT Key--unshifted

The unshifted **AUTO PRNT** Key behaves exactly the same as the unshifted **STEP** Key with the exception that every document that is searched is also printed.

6-5.14. AUTO PRNT Key--shifted

The shifted **AUTO PRNT** Key behaves exactly the same as the shifted **STEP** Key with the exception that every document that is searched is printed with the number of copies specified in the register.

6-5.15. RNGE Key

The **RNGE** Key is used to specify a range to be processed. This can be an **AUTO PRNT** range or a **STEP** range. The procedure for setting a range is to enter a number, press the **RNGE** Key enter a second number, and press the **RNGE** Key. The first number is the ending number in the range. All numbers are inclusive. The numbers can be a single number as in a single-level mode or a multi-level document number.

If either the starting or ending number is omitted, an Error Code will be shown on the Page Search Keyboard Display.

The **CLR** Key will terminate and erase any partially entered range command without changing the currently defined range as long as the **CLR** Key occurs before pressing the **RNGE** Key again.

6-5.16. SET Key

The **SET** Key is used as part of a two key sequence to set a parameter in the M-656 Page Search. If the **SET** Key is to be used in multi-level mode, the highest search level number will be used in the **SET** command. The block number will be used in three-level modes and the batch number will be used in two-level modes.

6-5.17. CART Key

With no document number previously entered, the **CART** Key will display the next cartridge number in memory. If all cartridge numbers have been displayed, the current memory location number will be reset to 1 and an error message displayed.

With a document number previously entered, the **CART** Key indicates that this is a cartridge number entered and not a frame number.

6-5.18. FRM Key

When no document number has been previously entered, the **FRM** Key will display the next frame number in memory. If there are no frame numbers or cartridge numbers in memory, an Error Code will be shown on the Page Search Keyboard Display and the current memory location will be set to 1.

With a document number previously entered, the **FRM** Key indicates that the number entered is a frame number. This is the default condition so this keystroke is not required to enter frame numbers.

6-5.19. INC/DEC Key--unshifted

The unshifted **INC/DEC** Key will increment the memory location number to the next memory location. It will display for about 0.75 second the new memory location number along with an indication whether the number stored is a cartridge number or frame number. It will then display the number of prints in the register with an indication of whether this is a batch print request. Then the stored number will display.

6-5.20. INC/DEC--shifted

The shifted **INC/DEC** Key will decrement the memory location number to the next memory location. It will display for about 0.75 second the new memory location number along with an indication whether the number stored is a cartridge number or frame number. It will then display the number of prints in the register with an indication of whether this is a batch print request. Then the stored number will display.

6-5.21. STOR Key--unshifted

The unshifted **STOR** Key stores data entered into the current memory location and automatically increments the memory location number to the next location. This allows repeated store operations without any need to modify the memory location number.

When no data has been previously entered, the unshifted **STOR** Key stores the current location on the film rather than any data keyed in.

6-5.22. STOR Key--shifted

The shifted **STOR** Key will display for about 0.75 second the current memory location number along with an indication whether the number stored is a cartridge number or frame number. Then the stored number will be displayed if one exists.

6-5.23. PRINT Key

With no preceding numbers entered, the **PRINT** Key will make one print of the current document.

If preceding numbers have been entered, the **PRINT** Key will print the number of copies specified.

6-6. KEYING SPECIAL FEATURES**6-6.1. Multiple Key Sequences****L, A**

Instructs the MPI to send message A.

B, AUTO PRNT

Used to resume an interrupted auto print function.

MODE, AUTO PRNT

See **AUTO PRNT** Key, Section 6-4.

SET, AUTO PRNT

Defines the number of print requests to be stored in the Memory Registers set by a future **STOR** Key entry.

L, B

Instructs the MPI to send message B.

L, CART

Instructs the MPI to print a cartridge pick list.

L, FRM

Instructs the MPI to print a frame pick list.

MODE, INC/DEC

See Section 6-4.

L, -

Instructs the MPI to not accept any further download and/or search requests.

L, +

Instructs the MPI to accept further download and/or search requests.

B, PRINT

Indicates a batch print is specified starting at the current location. The batch will be printed in reverse order starting at the end of the batch and stopping at the beginning of the batch containing the document on which the **PRINT** Key was pressed.

SET, B

Does the film movement of B Print without actually making any prints.

CLR, RNGE

Erases any currently stored range.

MODE, RNGE

Displays any currently stored range.

B, SET

Used to set a new stepping position of the document on the Viewing Screen. If preceded by a number, the sequence indicates this is a new registration stopping count. If not preceded by a number, the Page Search waits for the Operator to move the film to the desired stopping position using the Manual Scan Control and pressing **CLR**.

B, STEP

Used to resume an interrupted step function.

MODE, STEP

See **STEP** Key, Section 6-4.

SET, STEP

Used to specify the number of tenths of a second to delay between frames. The document number preceding the **SET** Key will be used as the number of tenths of a second to delay.

Example: **100, SET, STEP** will set the delay time to 10 seconds.

B, STOR

Indicates the stored frame number is a batch print request.

CLR, STOR

Erases all storage registers.

FRM, STOR

Functions the same as the **STOR** Key.

MODE, STOR

Displays the current register number and values.

RSET, STOR

Indicates the stored number is a preset number.

SET, STOR

Used to set the memory location pointer to the specified value. Example: **1, SET, STOR** will set the memory location pointer to 1.

6-7. AUTOMATIC FUNCTIONS**6-7.1. Interrupting Automatic Functions**

Temporary suspension is allowed by either an error or pressing the **CLR** Key. If an auto-print is interrupted with an error, the print for that frame is not made. While the function is suspended, the **PRINT**, **RUN**, **+**, **-**, and **REST** Keys may be used without terminating the function.

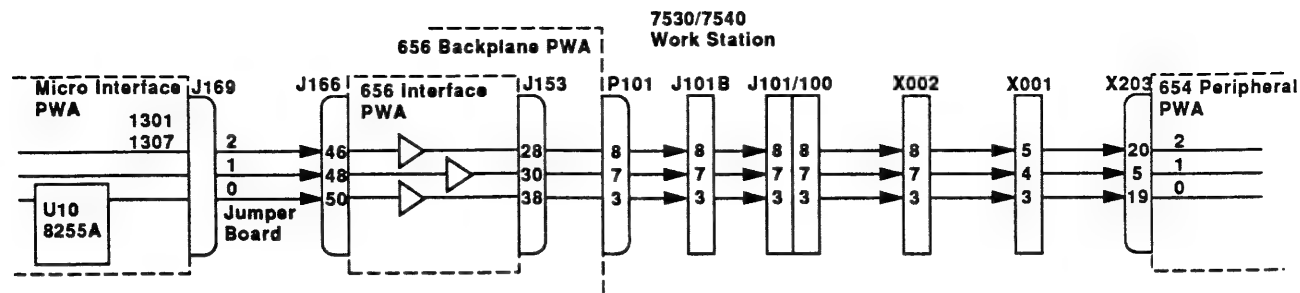
6-7.2. Resumption of Interrupted Automatic Functions

When an automatic function such as step or auto-print is interrupted by pressing **CLR**, the **MODE**, **STEP** or **MODE, AUTO PRNT** Keying Sequence is required to start the function.

6-7.3. Batch Printing

The M-656 Page Search can print all documents in a block or batch automatically. If the request is given while on a block, the whole block will be printed. If the request is given while on a batch, the whole batch will be printed. The documents will be printed in reverse order in order to allow the prints to be in correct order when finished.

6-8. COMMAND LINES

**MOTOR SPEED CONTROL 0, 1, and 2**

M656 to M-654

1301 to 1307

Description:

These three lines carry transport motor speed and direction commands from the M-656 to the M-654. The lines are active only if a transport drive command is input from the M-656 Keyboard. The binary combination of highs and lows on the lines (000 to 111) specifies any of seven speed commands as follows:

Low Speed Forward (LSF)
 Low Medium Speed Forward (LMSF)
 Medium Speed Forward (MSF)
 High Speed Forward (HSF)

Low Speed Reverse (LSR)
 Medium Speed Reverse (MSR)
 High Speed Reverse (HSR)

The M-654 translates these commands into speed "count" commands in its speed control circuits as follows:

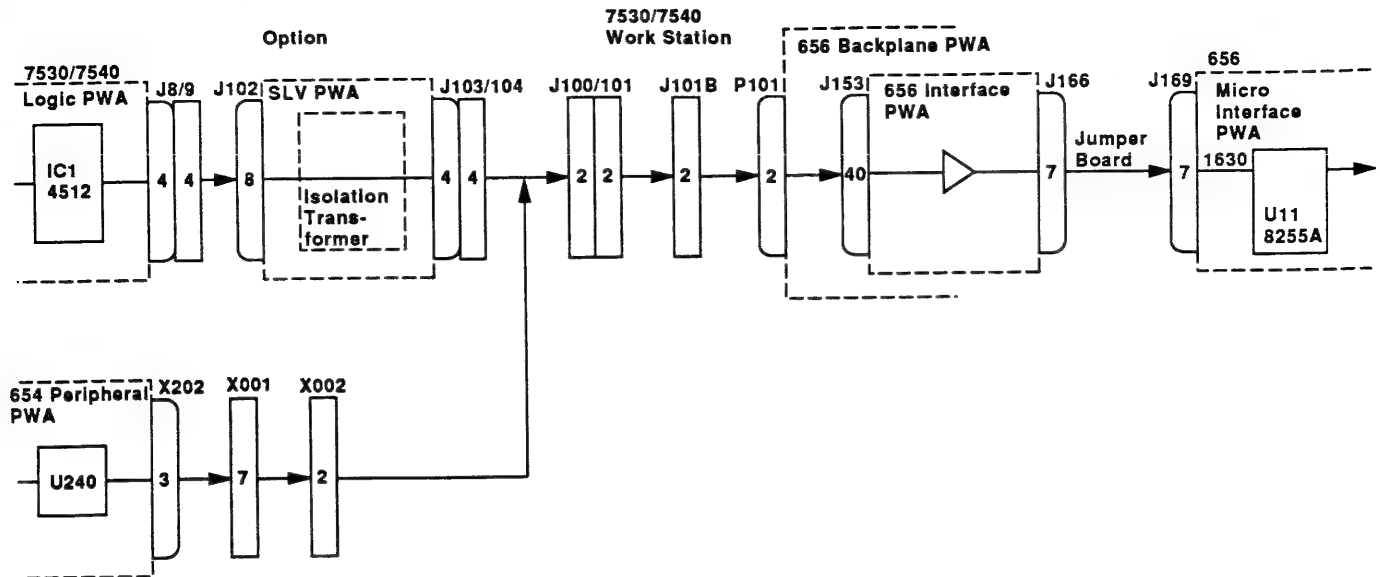
LSF = 3 (4.8 mm/sec, 0.19 in./sec)
 LMSF = 30 (50 mm/sec, 1.97 in./sec)
 MSF = 230 (370 mm/sec, 14.6 in./sec)
 HSF = 1900 (3060 mm/sec, 120.5 in./sec)

LSR = -3 (4.8 mm/sec, 0.19 in./sec)
 MSR = -230 (370 mm/sec, 14.6 in./sec)
 HSR = -1900 (3060 mm/sec, 120.5 in./sec)

Note: The Speed Control on the M-654 is disabled whenever the **MOTOR SPEED CONTROL** lines are active (any binary combination but 111).

To Check:

1. Rewind film and remove the film cartridge.
2. Switch OFF the M-656.
3. Switch OFF the M-7530/7540.
4. Disconnect and remove the M-654.
5. Remove the Rear Cover from the M-654.
6. Switch OFF the Service Switch for the M-654 to enter the Diagnostic Mode for the M-654.
7. Reconnect the M-654.
8. Switch ON the M-656.
9. Switch ON the M-7530/7540.
10. Turn the M-654 Film Speed Control counterclockwise to Diagnostic Code 23. The M-654 Digital Display should read 10 to indicate there is no film movement.
11. From the M-656 Keyboard, press CLR and enter 3597 L to enter the Diagnostic Mode for the M-656.



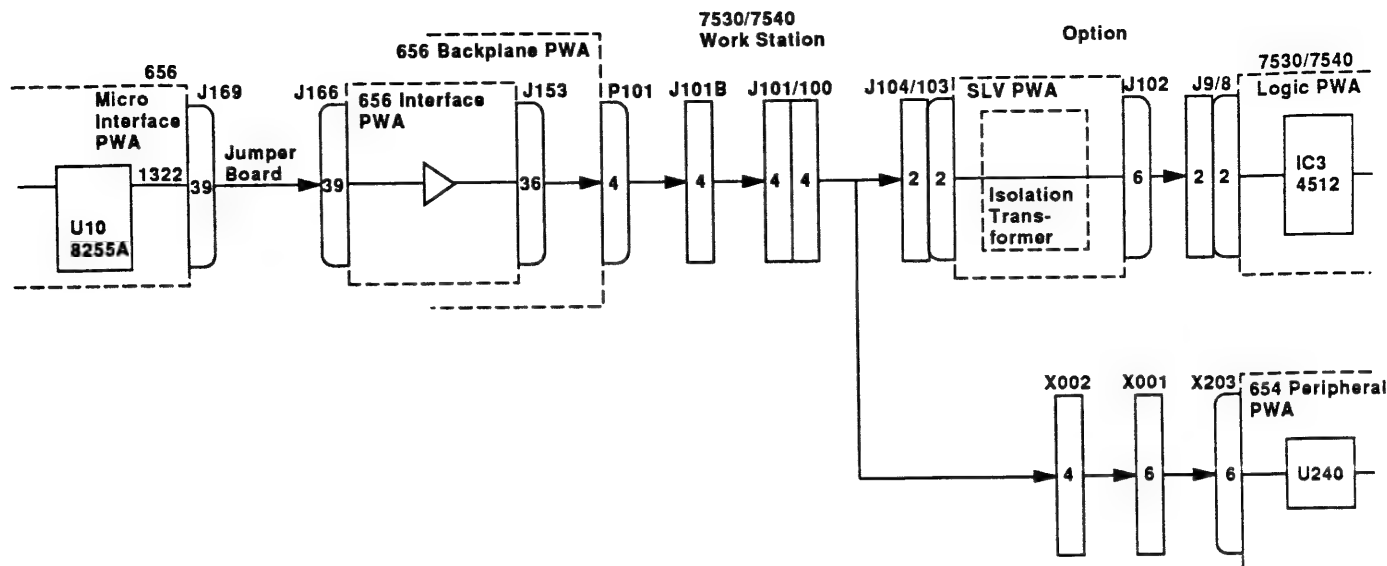
CTRG M-654 the M-656 and M-7530/7540 1639

Description:

A high to low transition on this line indicates that a cartridge has been inserted, and a film load cycle is underway. The signal also switches on the Exposure Lamp. A low to high transition switches off the Exposure Lamp. The CTRG signal is initiated by Cartridge Switch (S4) when a cartridge is inserted.

To check: See also page 8-12.

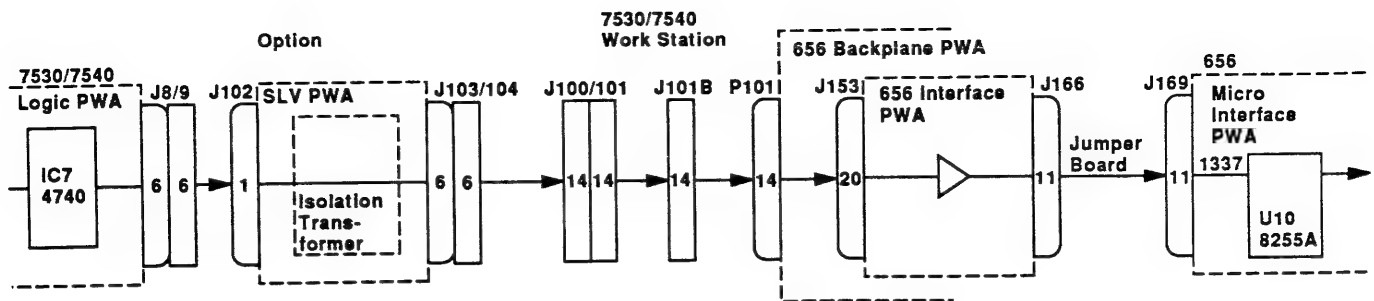
1. Rewind film and remove the film cartridge.
2. Switch OFF the M-7530/7540 and M-656.
3. Remove the M-654 Rear Cover and set the Service Switch (S15) to OFF to enter the Diagnostic Mode.
4. Switch ON the M-656.
5. Switch ON the M-7530/7540.
6. Turn the M-654 Film Speed Control to 53 and press the Reset Switch.
7. Turn the Film Speed Control fully counterclockwise then clockwise to read 0 on the M-654 Digital Display.
8. From the M-656 Keyboard, press CLR and enter 3597 L to enter the diagnostic mode.
9. Enter 1639 L. The M-656 Keyboard Display should read 00011101.
10. Press the Reset Switch. The M-656 Keyboard Display should read 00011100, the M-7530/7540 READY LAMP and Exposure Lamp should light.
11. Press or release the Reset key to toggle (the Exposure Lamp will remain on).
12. Set the M-654 Diagnostic Switch On to return to normal operation.
13. Load a film cartridge in the M-654. The M-656 Keyboard Display should read 00011100.

**S-AVAIL M-656 to M-7530 and M-654****1322****Description:**

A low level signal on this line indicates that the M-656 is connected in the system, power is applied to it, and it has passed its power-up self-test. The "Searcher Available" signal disables the 9-digit Keyboard, the Clear/Stop Key, and the Digital Display on the M-7530/7540. It also disables the Digital Display on the M-654.

To check:

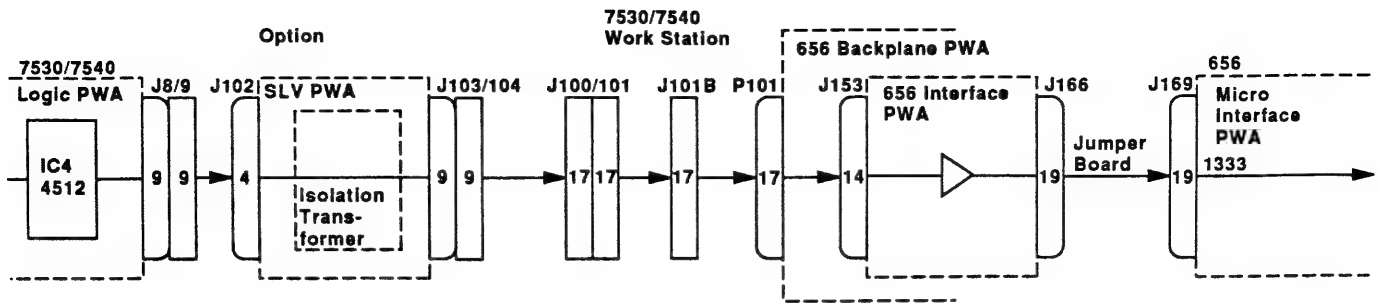
1. Switch OFF the M-7530/7540.
2. Switch OFF the M-656.
3. Disconnect and remove the M-654.
4. Remove the Rear Cover of the M-654.
5. Switch OFF the Service Switch for the M-654 to enter the Diagnostic Mode for the M-654.
6. Reconnect the M-654.
7. Switch ON the M-656.
8. Switch ON the M-7530/7540. The M-7530/7540 Digital Display, Keyboard, Clear/Stop Key and Print Key will be inactive (Page Search active). The View/Standby Key remains active.
9. Turn the M-654 Film Speed Control counterclockwise to Diagnostic Code 23. The display should read **2310** (indicates **S-AVAIL** is active and film motor speed inactive).
10. From the M-656 Keyboard, press CLR and enter **3597 L** to enter the Diagnostic Mode for the M-656.
11. Enter Diagnostic Code **1322** and press L.
12. Press CLR. The M-654 Digital Display will read **2300**, and the M-7530/7540 Digital Display, Keyboard, Clear/Stop Key and Print Key will be inactive (Page Search inactive).
13. Enter **1322 L** or CLR to toggle.
14. Switch OFF the M-7530/7540.
15. Switch OFF the M-656.
16. Switch ON the M-654 Service Switch to return to normal operation.

**S-INIT (M-7530 to M-656)****1337****Description:**

A high level on this line occurs when power is removed from the M-7530/7540, or the M-7530/7540 goes into standby mode (Exposure Lamp turns off). A low signal on this line indicates that the M-7530/7540 is powered. This **S-INIT** signal sets the M-656 into standby mode, turning off the keyboard and all drivers.

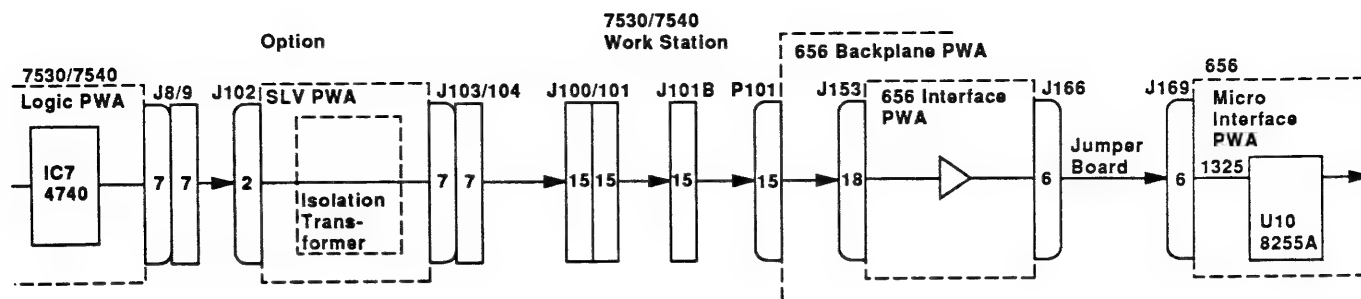
To check:

1. Switch ON the M-656.
2. Switch ON the M-7530/7540.
3. From the M-656 Keyboard, press **CLR** and enter **3597 L** to enter the Diagnostic Mode for the M-656.
4. Enter Diagnostic Code **1337** and press **L**. The M-656 Keyboard Display should read **0** (active). The M-656 Keyboard Display will read **1** if the Exposure Lamp is off.
5. Press the View/Standby Key. The M-656 Keyboard should read **1** (inactive).
6. Press the **VIEW/STANDBY** Key to toggle.
7. Switch OFF the M-7530/7540. The M-656 Keyboard Display should read **1**.
8. Switch ON the M-7530/7540. the M-656 Keyboard Display should read **0**.
9. Press the M-7530/7540 Power Switch to toggle.
10. Switch OFF the M-7530/7540.
11. Switch OFF the M-656.

**PRINT COUNT M-7530 to M-656****1333****Description:**

A low going 80 to 150 millisecond pulse on this line indicates a print has been made.

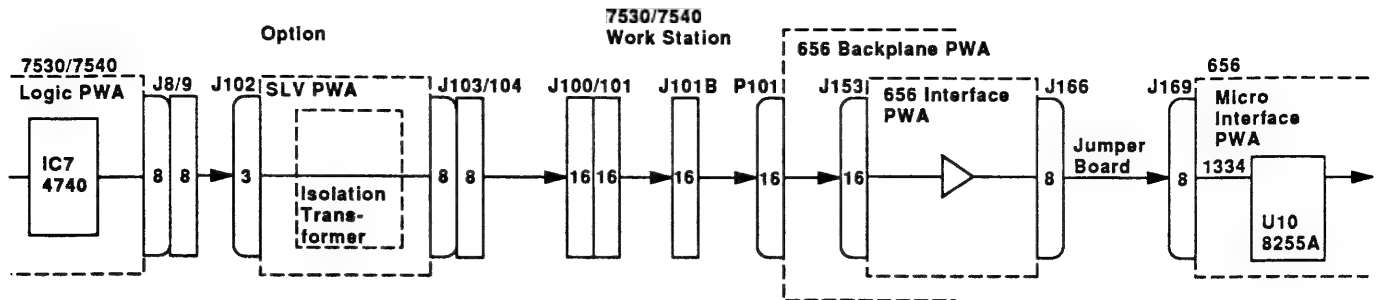
1. Switch ON the M-656.
2. Switch ON the M-7530/7540.
3. From the M-656 Keyboard, press **CLR** and enter **3597 L** to enter the Diagnostic Mode for the M-656.
4. Enter Diagnostic Code **1322 L** and press **CLR** to transfer print control to the M-7530/7540.
5. Enter **1333 L**. The M-656 Keyboard Display should read **1**.
6. Press the M-7530/7540 **PRINT** Key. The M-656 Keyboard Display should flash a **0** during the print cycle and then back to **1** after the cycle is completed.
7. Press any numerical key on the M-7530/7540 control panel and **PRINT** to toggle.
8. Switch OFF the M-7530/7540.
9. Switch OFF the M-656.

**P-RUN 7530/7540 to M-656****1335****Description:**

A low level on this line indicates that a print is being run. Film cannot be moved by keyboard manipulation while this signal is low. It can be moved by the M-654 Scan Control, however.

To check:

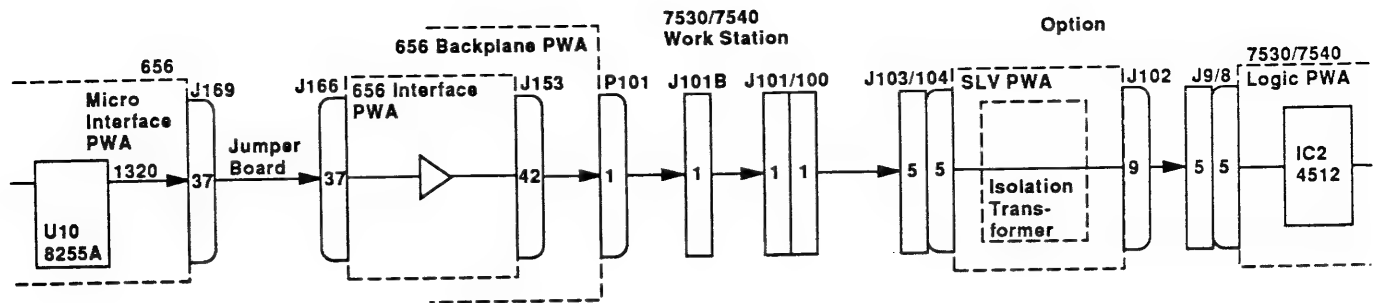
1. Switch On the M-656.
2. Switch ON the M-7530/7540.
3. From the M-656 Keyboard, press **CLR** and enter **3597 L** to enter the Diagnostic Mode for the M-656.
4. Enter Diagnostic Code **1322 L** and press **CLR** to transfer print control to the M-7530/7540.
5. Enter **1335 L**. The m-656 Keyboard Display should read 1.
6. Press any numerical key except 1 on the M-7530/7540 control panel.
7. Observing the M-656 Keyboard Display, press the M-7530/7540 **PRINT** Key. The M-656 Keyboard Display should change to 0 during the first print cycle, flash 1 near the end of the last print cycle, and remain at 1 at the end of the print run. If only a single print is made, the Keyboard display would momentarily change from 1 to 0 near the end of the print cycle.
8. Press any M-7530/7540 numerical key and **PRINT** to toggle.
9. Switch OFF the M-7530/7540.
10. Switch OFF the M-656.

**WARNING** M-7530/7540 to M-656**1334****Description:**

A low level occurs on this line whenever there is a paper jam, the Paper Cassette is empty, the Toner supply is low (will shut down the M-656 but the M-654 will continue to operate), or the Used Toner Bag is full. The **WARNING** signal from the Paper Feed Switch and the Auto Toner Door causes the M-656 Keyboard to flash Error Code **50** to alert the operator to refer to the M-7530/7540 indicator lamps.

To check:

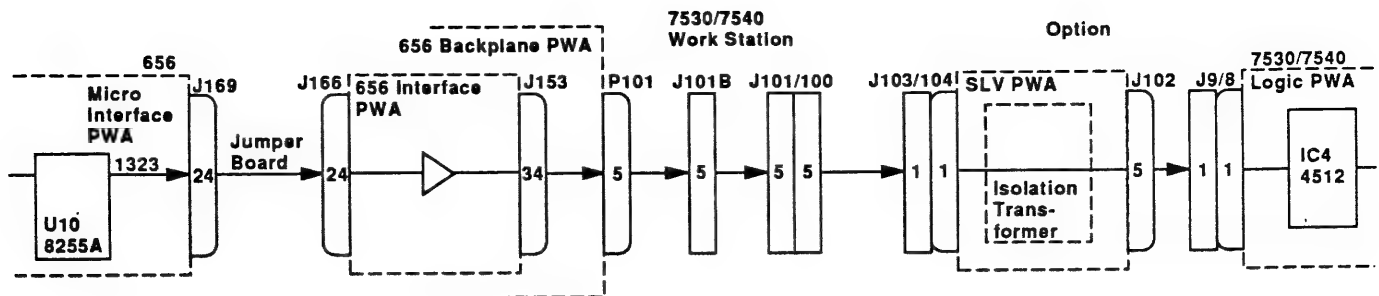
1. Ensure the M-7530/7540 has paper loaded in the Paper Cassette.
2. Switch ON the M-656.
3. Switch On the M-7530/7540.
4. Load a film cartridge in the M-654.
5. From the M-656 Keyboard, press **CLR** and enter **3597 L** to enter the Diagnostic Mode for the M-656.
6. Enter Diagnostic Code **1334** and press **L**. The M-656 Keyboard Display should read **1** (no warning).
7. Pull out the Paper Cassette. The Keyboard Display should read **0**, the M-7530/7540 **ADD PAPER** indicator should light, and the M-7530/7540 **READY LAMP** should go out.
8. Push in the Paper Cassette. The Keyboard Display should read **1**, the **ADD PAPER** indicator should go out, and the **READY LAMP** should light.
9. Move the Paper Cassette in or out to toggle.
10. Press **CLR** to leave the Diagnostic Mode.
11. Open the Right Side Door and defeat the interlock.
12. Raise the Print Engine and press the **PRINT** Key on the M-656 Keyboard. The M-656 Keyboard Display should read Error Code **50**, the M-7530/7540 **CLEAR PAPER JAM** indicator should light, and the **READY LAMP** should go out.
13. Press **CLR** and enter **1334 L**. The M-656 Keyboard Display should read **0**.
14. Clear the paper jam.
15. Switch OFF the M-7530/7540.
16. Switch OFF the M-656.
17. Switch ON the M-656.
18. Switch ON the M-7530/7540.
19. Press **CLR** and enter **3597 L 1334 L**. The M-656 Keyboard Display should read **1** after the M-7530/7540 **READY LAMP** lights.
20. Remove the Stripper Finger Assembly.

**S-BUSY M-656 to M-7530****1320****Description:**

The "Searcher Busy" signal is held at a high level while the M-656 is controlling a film search.

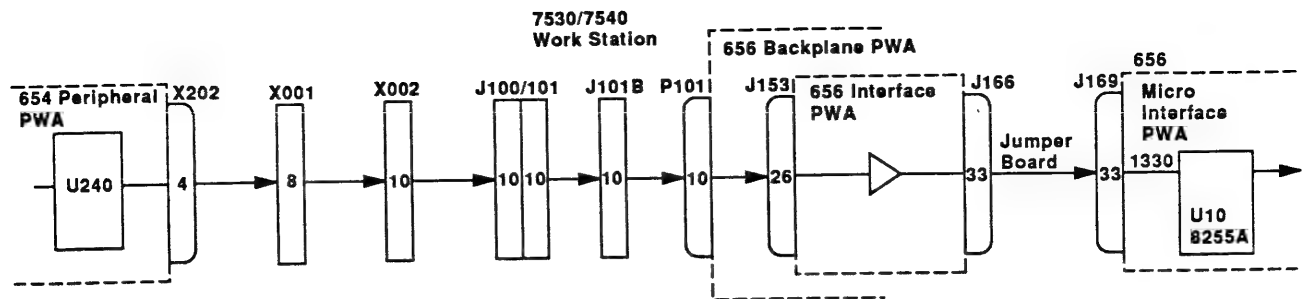
To check:

1. Switch ON the M-656.
2. Switch ON the M-7530/7540.
3. Load a film cartridge in the M-654. The Ready Lamp on the M-7530/7540 will light and film will auto-thread.
4. From the M-656 Keyboard, press **CLR** and enter **3597 L** to enter the Diagnostic Mode for the M-656.
5. Enter Diagnostic Code **1320 L**.
6. Press **CLR**. The Ready Lamp should go out.
7. Enter **1320 L**. The Ready Lamp should light.
8. Enter **CLR** or **1320 L** to toggle.
9. Switch OFF the M-7530/7540.
10. Switch OFF the M-656.

**PRINT M-656 to M-7530/7540****1323****Description:**

A low level signal on this line requests a print from the M-7530/7540. As long as the line is held low, the M-7530/7540 will continue to make prints. The **PRINT** signal is synchronized with the **PRINT COUNT** signal.

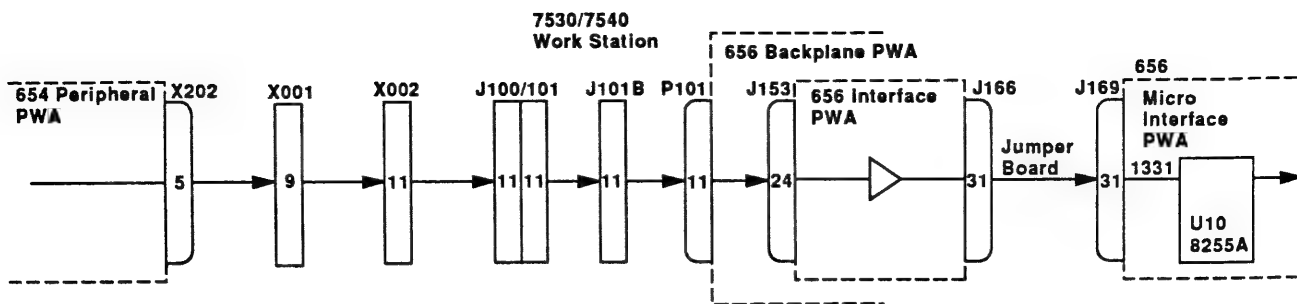
1. Switch ON the M-656.
2. Switch ON the M-7530/7540.
3. Load a film cartridge into the M-654.
4. From the M-656 Keyboard, press **CLR** and enter **3597 L** to enter the Diagnostic Mode for the M-656.
5. Enter Diagnostic Code **1323** and press **L**. The M-7530/7540 should continue to make prints until **CLR** is pressed.
6. Press **CLR**. Prints will cease to be made.
7. Enter **1323 L** or press **CLR** to toggle.
8. Switch OFF the M-7530/7540.
9. Switch OFF the M-656.

**FILM LOADED M-654 TO M-656****1330****Description:**

A low level on this line indicates to the M-656 that film is loaded in the M-654 (Film Sensor (S6) in the M-654 senses film). This signal enables the M-656 software to count blips and to transmit print requests to the M-7530/7540 when the M-656 **PRINT** Key is pressed.

To check: See also page 8-12

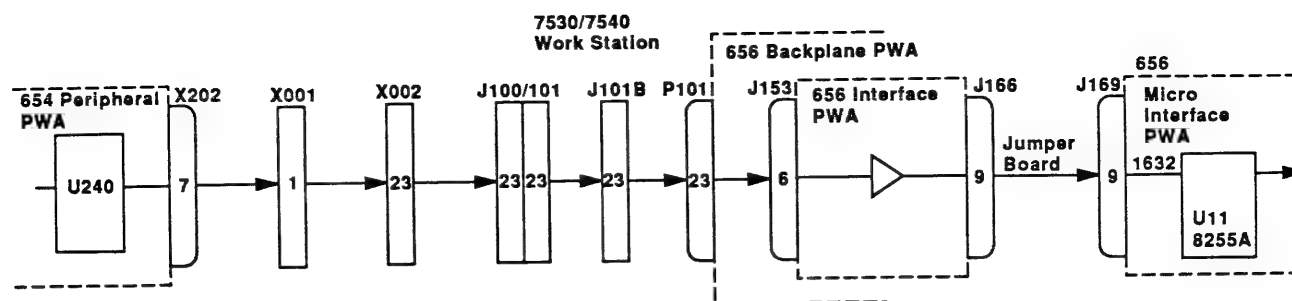
1. Rewind film and remove the film cartridge.
2. Switch OFF the M-656.
3. Switch OFF the Reader-Printer.
4. Disconnect and remove the M-654.
5. Remove the Rear Cover of the M-654.
6. Switch OFF the Service Switch for the M-654 to enter Diagnostic Mode for the M-654.
7. Reconnect the M-654.
8. Switch ON the M-656.
9. Switch ON the M-7530/7540.
10. Turn the M-654 Film Speed Control counterclockwise to Diagnostic Code 53.
11. Press the Reset Button.
12. Turn the Film Speed Control fully counter clockwise, then clockwise to 1.
13. From the M-656 Keyboard, press **CLR** and enter **3597 L** to enter the Diagnostic Mode for the M-656.
14. Enter Diagnostic Code **1330** and press **L**.
15. Press the M-654 Reset Switch. The M-656 Keyboard Display should read **0**.
16. Press or release the Reset Switch to toggle.
17. Enter **1339 L**. The M-656 Keyboard Display should read **11111111**. If the Exposure Lamp is on, the display will read **01111111**.
18. Press the M-654 Reset Switch. The M-656 Keyboard Display should read **11111110**.
19. Switch ON the M-654 Diagnostic Switch to return to normal operation.
20. Press **CLR** and enter **1330 L**. The M-656 Keyboard Display should read **1**.
21. Load a film cartridge in the M-654. The M-656 Keyboard Display should read **0** at the end of auto-thread.
22. Switch OFF the M-7530/7540.
23. Switch OFF the M-656.

**XPORT N AVAIL M-654 to M-656****1331****Description:**

A high level signal on this line indicates that power is removed from the M-654 or that the M-654 has failed its self-test. (A no-power situation normally means that power is not applied to the M-7530/7540, which provides 27 VAC to the M-654.)

To check: See also page 8-12

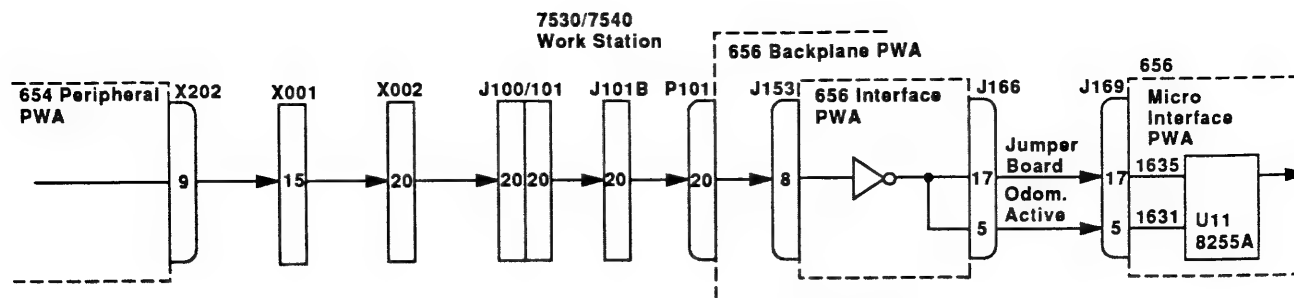
1. Rewind film and remove the film cartridge.
2. Switch OFF the M-656.
3. Switch OFF the Reader-Printer.
4. Disconnect and remove the M-654.
5. Remove the Rear Cover from the M-654.
6. Switch OFF the Service Switch for the M-654 to enter the Diagnostic Mode for the M-654.
7. Reconnect the M-654.
8. Switch ON the M-656.
9. Switch ON the M-7530.7540.
10. Turn the M-654 Film Speed Control counterclockwise to Diagnostic Code 53.
11. Press the Reset Button.
12. Turn the Film Speed Control fully counter clockwise, then clockwise to 2.
13. From the M-656 Keyboard, press CLR and enter 3597 L to enter the Diagnostic Mode for the M-656.
14. Enter Diagnostic Code 1331 and press L. The M-656 Keyboard Display should read 1.
15. Press the M-654 Reset Switch. The M-656 Keyboard Display should read 0.
16. Press or release the Reset Switch to toggle.
17. Enter 1339 L. The M-656 Keyboard Display should read 11111111. (If the Exposure Lamp is on, the display will read 01111111.
18. Press the M-654 Reset Switch. The M-656 Keyboard Display should read 11111101.
19. Switch On the M-654 Diagnostic Switch to return to normal operation.
20. Press CLR and enter 1331 L. The M-656 Keyboard Display should read 0.
21. Switch OFF the M-7530/7540. The M-656 Keyboard Display should read 1.
22. Switch OFF the M-7530/7540.

**ERROR M-654 to M-656****1639****Description:**

A low-going signal on this line indicates to the M-656 that a M-654 transport error has occurred. It causes the M-656 to generate error code **30** on its Display.

To check: See also page 8-12

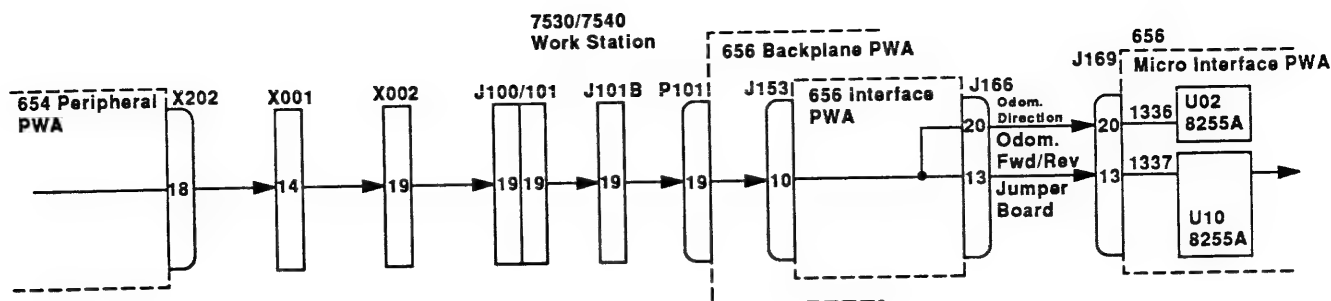
1. Rewind film and remove the film cartridge.
2. Switch OFF the M-7530/7540.
3. Switch OFF the M-656.
4. Remove the Rear Cover from M-654.
5. Switch OFF the Service Switch for the M-654 to enter the Diagnostic Mode.
6. Switch ON the M-656.
7. Switch ON the M-7530/7540.
8. Turn the M-654 Film Speed Control to **53** and press the Reset Switch.
9. Turn the film Speed control fully counterclockwise then clockwise to read **4** on the M-654 Digital Display.
10. From the M-656 Keyboard, press CLR and enter **3597 L** to enter the diagnostic mode.
11. Enter **1639 L**. The M-656 Keyboard Display should read **00011101**.
12. Press the Reset Switch. The M-656 Keyboard Display should read **00011001**.
13. Press or release the Reset Key to toggle.
14. Set the M-654 Diagnostic Switch ON to return to normal operation.
15. Move the M-654 Manual Eject Lever to the rear. The M-656 Keyboard Display should read **00011001**, **00000000**, then back to **00011101** as the M-654 clears itself of the error. Error Code **3** should read on the M-654 Digital Display. Pressing the Reset Key, the display should read **3570**.
16. Switch OFF the M-7530/7540.
17. Switch OFF the M-656.

**ODOMETER COUNT M-654 to M-656****1639****Description:**

The signal on this line is a train of negative-going pulses (odometer counts) from the M-654 odometer processing circuit. 400 pulses represent one inch of film travel. The odometer count, which serves as a measure of the distance of film travel, is used by the M-656 page search in two ways: (1) Circuits on the Page Search PWA use the count to determine the size (large, medium, or small) of sensed blips. Blip sizing is done by calculating the distance film travels while a blip is being sensed. (2) In addition, the count is required by the page search software to position the film image a precise distance from the point at which a blip is sensed to the point at which the corresponding image must be placed for viewing and printing.

To check:

1. Switch ON the M-656.
2. Switch ON the M-7530/7540.
3. Load a film cartridge in the M-654.
4. From the M-656 Keyboard, press CLR and enter 3597 L to enter the Diagnostic Mode for the M-656.
5. Enter Diagnostic Code 1639 and press L. The M-656 Keyboard Display should read 00011100.
6. Turn the Manual Scan Control counter-clockwise. The M-656 Keyboard Display should read 00011110.
7. Turn the Manual Scan Control clockwise. The M-656 Keyboard Display should read 00011110.
8. Turn the Manual Scan Control to toggle.
9. Turn the Film Speed Control counter-clockwise. The M-656 Keyboard Display should read 00011110.
10. Turn the Film Speed Control clockwise. The M-656 Keyboard Display should read 00011111.
11. Turn the Film Speed Control to toggle.
12. Switch OFF the M-7530/7540.
13. Switch OFF the M-656.



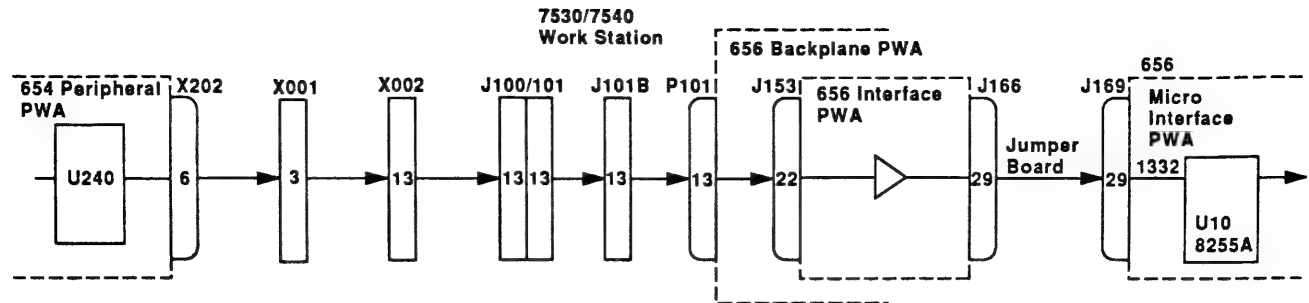
ODOMETER DIRECTION M-654 to M-656 1336

Description:

This signal indicates the direction of film travel. A low level indicates forward travel, and a high level indicates reverse.

To check:

1. Switch ON the M-656.
2. Switch ON the M-7530/7540.
3. Load a film cartridge in the M-654.
4. From the M-656 Keyboard, press CLR and enter 3597 L to enter the Diagnostic Mode.
5. Enter 1336 L. The M-656 Keyboard Display will read a 1 to indicate forward or 0 to indicate reverse.
6. Turn the Film Speed Control clockwise. The M-656 Keyboard Display should read 1.
7. Turn the Film Speed Control counterclockwise. The M-656 Keyboard Display should read 0.
8. Rewind film leaving the Film Speed Control fully counterclockwise. The M-656 Keyboard Display should read 0.
9. Load a film cartridge in the M-654. The M-656 Keyboard Display should change to 1 during auto-thread and back to 0 to indicate the last direction of film movement selected.
10. Switch OFF the M-7530/7540.
11. Switch OFF the M-656.

**END OF FILM M-654 to M-656****1332****Description:**

A low level on this line indicates to the M-656 that the M-654 is approaching end of film in the forward direction. The M-656 will slow down, then stop the film after sensing the last blip. If the film is simplex type (one row of blips), the M-656 will then generate error code 23. If the film contains blips in both the A and B rows, the M-656 will activate the B row counting function, so that counting can continue in the B row when transport traverse occurs.

To check:

1. Rewind film and remove the film cartridge.
2. Switch OFF the M-656.
3. Switch OFF the M-7530/7540.
4. Disconnect and remove the M-654.
5. Remove the Rear Cover of the M-654.
6. Switch OFF the Service Switch for the M-654 to enter Diagnostic Mode for the M-654.
7. Reconnect the M-654.
8. Switch On the M-656.
9. Switch On the M-7530/7540.
10. Turn the M-654 Film Speed Control counterclockwise to Diagnostic Code 53.
11. Press the Reset Button.
12. Turn the Film Speed Control fully counter clockwise, then clockwise to 3.
13. From the M-656 Keyboard, press CLR and enter 3597 L to enter the Diagnostic Mode for the M-656.
14. Enter Diagnostic Code 1332 and press L. The M-656 Keyboard Display should read 1.
15. Press the M-654 Reset Switch. The M-656 Keyboard Display should read 0.
16. Press or release the reset Switch to toggle.
17. Switch OFF the M-654 Diagnostic Switch to return to normal operation.
18. Load a film cartridge. The M-656 Keyboard Display should read 1.
19. Turn the Film Speed fully clockwise to drive film to the end of the reel. Near the end of the reel, the M-656 Keyboard Display should change to 0.
20. Switch OFF the M-7530/7540.
21. Switch OFF the M-656.

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* 7-9.	System Functional Diagram	

* Located in the binder pocket

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8-1. "PAGE SEARCH" DIGITAL DISPLAY CODES

This section defines all operator messages and error codes pertaining to page search that can be displayed by the M-7530/7540 with Page Search System. All codes are preceded on the Main Keyboard Display by a series of "c's". For example: cccccc08 specifies that the machine is in the Standby Mode.

When a code is displayed on the Page Search Keyboard Display:

1. Press **CLR** to remove the code from the Page Search Keyboard Display.
2. Determine the problem as identified in Table 8-1.
3. Perform the action given in Table 8-1.

Note

For all codes that indicate an actual machine error (as opposed to a routine system message to the operator), retry the machine function that caused the error to confirm the error before proceeding with remedial action. If codes not defined in the table occur; power off, then on, and retry the function.

TABLE 8-1. M-656 "PAGE SEARCH" DIGITAL DISPLAY CODES

Code	Problem	Action
Page Search Operator Messages		
10	You are not allowed to change modes with film loaded.	Press CLR , then press RUN to rewind film.
12	Film Cartridge not loaded	Load Film Cartridge and press CLR .
14	Search is in A Row.	Press CLR , then use Film Traverse Control, to display B row image.
15	Search is in B Row.	Press CLR , then use Film Traverse Control, to display B row image.
20	Document position queue data is wrong. Odometer may be malfunctioning.	Do M654 Odometer Sensor (S7) Adjustment.
22	Reset is not allowed. No documents are in the film gate.	Rewind and resume operation.
23	End of film has been sensed.	If film is at end of reel, press CLR and rewind or enter a new number for search.
24	Too large a search number has been entered (greater than actual number of blips on film in current Batch or Block.	Press CLR to display current location. Press - to back up film to show current item count.
26	System did not locate a blip on film within 9 seconds after CLR was pressed.	Check that film has blips. If so, see Troubleshooting Figure 8-13.
27	Film has rewound during search for a document. (An invalid number was entered, film is not blipped or machine is not counting.)	Check for properly blipped film. If film is OK, see Troubleshooting Figure 8-13.
28	Film is not loaded.	Load a cartridge.
29	RSET button used incorrectly.	Enter a number before pressing RSET .

TABLE 8-1. (Continued)

Code	Problem	Action
Film Transport Problems		
30	Transport Error.	See M-654 Odometer/Digital Display.
36	System interface problem.	Check Interface Harness between M-7530 and M-656.
Reader-Printer Problems		
50	Reader-Printer Error.	<u>WARNING</u> See M-7530 Digital DisplayCommand WARNING. page
51	Reader-Printer Error.	<u>PRINT COUNT</u> See M-7530 Digital DisplayCommand PRINTCOUNT. page
52	Reader-Printer Error.	<u>P RUN</u> See M-7530 Digital DisplayCommand P-RUN. page
Keying/Search Problems		
60	Key was pressed out of sequence.	Operator error. Press CLR and retry.
61	Invalid diagnostic code was keyed in.	Operator error. Press CLR and retry.
62	Too many keys have been pressed.	Operator error. Press CLR and retry.
63	L Key has been pressed in an incorrect sequence.	Operator error. Press CLR and retry.
64	Too many prints have been requested.	Operator error. Press CLR and retry.
65	A Key has been pressed too many times.	Operator error. Press CLR and retry.
66	An invalid mode number has been entered (1-18 are valid).	Operator error. Press CLR and retry.
67	You have entered an invalid parameter number.	Operator error. Press CLR and retry.
68	Count at Blip Sensors is lost.	Reset or rewind film. Retry search.
Power-Up Self-Test Errors		
On Self Test Errors Reset to Default (3597L 8024L)		
70	LRC error in EPROMs.	Press CLR. (Ref Codes 901-906.)
71	RAM error.	Retry. If error recurs, replace Micro PWB.
78	Revision levels of EPROMs do not match.	Replace EPROMs with matching set.
79	LRC error in EEPROM.	Retry. If error recurs, replace Micro PWB.
Timing/Software/Micro-System Errors		
94	Page Search software lost the count.	Press CLR to clear the error. If error recurs, replace Micro PWB.
95	FIFO overrun in Keyboard/Display Interface Chip on Micro PWB.	Press CLR to clear the error. If error recurs, replace Micro PWB. Ground 656 Chassis to 7530 Chassis.
96	FIFO overrun in Keyboard/Display Interface Chip on Micro PWB.	Press CLR to clear the error. If error recurs, replace Micro PWB. Remove M654 Groundwire from Ferrite Core.
98	Error code queue overflow.	May require resetting Page Search ON/OFF Switch to clear error. If error recurs, replace Micro PWB.
99	Page Search System software error.	May require resetting Page Search ON/OFF Switch to clear error. If error recurs, replace Micro PWB.

TABLE 8-1. (Continued)

Code	Problem	Action
Page Search Keying Messages		
200	No cartridge numbers are stored in Memory Registers.	No system problem.
201	No cartridge or frame numbers are stored in Memory Registers.	No system problem.
203	You have stored a number in last (50th) Memory Register.	No system problem.
204	You have entered an invalid register number (1 through 50 are valid).	No system problem.
205	Current machine mode is not compatible with format of frame numbers stored in Memory Registers.	No system problem.
206	You have specified an invalid register number in your range entry (1 through 50 are valid).	No system problem.
207	MODE RUN is not valid if a previous search has not occurred.	No system problem.
208	Batch printing cannot be initiated because film was moved "manually."	No system problem. Use Keyboard to locate desired block or batch for printing.
210	A pause greater than 15 seconds is not valid.	No system problem.
211	B STEP or B AUTOPRNT is used to resume an interrupted Step or Autoprint function.	No system problem. Step or Autoprint has not been interrupted.
220	Bar code number for the cartridge does not match the number on the loaded cartridge.	No system problem.
221	Bar Code has specified an unknown search mode.	No system problem.
400 : 599	These codes indicate improper control of film positioning. This is an M-654 Transport problem that can be caused by 0 counter, Film Speed Faults, or 654 coasting problems.	Refer to M-654 Field Service File.
650 : 799	These codes identify Serial Communications problems or messages.	Refer to API/BPI Field Service Handbook.

PROM LRC Error Isolation Codes

901	LRC error is in PROM U1.	Replace Micro PWB.
902	LRC error is in PROM U9.	Replace Micro PWB.
903	LRC error is in PROM U2.	Replace Micro PWB.
904	LRC error is in PROM U8.	Replace Micro PWB.
905	LRC error is in PROM U3.	Replace Micro PWB.
906	LRC error is in PROM U10.	Replace Micro PWB.

8-2. DIAGNOSTIC FUNCTION KEYBOARD ENTRY CODES (Continued)

Code Function

CHECKS OF SENSE PORT C ON U11

- 1630* Check the CTRG line from the M-654. (0 = cartridge loaded.)
 1631* Check the ODOMETER ACTIVE line.
 1632 Check the ERROR line from the M-654. (0 = error.)
 1635 Check the ODOMETER COUNT line.
 1636 Not used.
 1637 Not used.
 1639 Display all signals input to Port C on U11.

1637 1630
 ↓ ↓
 0 0 0 0 0 0 0 0

Note: *This line can be activated from the M-654 via diagnostic code 53. See the M-654 Troubleshooting Section, page 8-11.

	S Init	Odom. Fwd/Rev 1 = Fwd 0 = Rev	P-Run 0 = Print Is running	Warning 0 = 654 Error	Print Count 0 Causes Count	End of Film 0 = End of Film	Export N Avail. 0 = Avail. 1 = Not Avail.	Film Loaded 0 = Loaded 1 = Not Loaded
1339 (Cartridge loaded)	0	0	1	1	1	0	0	
Standby	0	1	1	1	1	0	1	
Searching (Forward)	1	0	1	1	1	0	0	

8-3. DIAGNOSTIC ROUTINES

This table describes functions of the 4-digit codes that can be used to initiate Diagnostic Routines.

1. To initiate a particular Diagnostic Mode.
 - Press CLR and enter **3597 L** to enter the Diagnostic Mode.

Note

This step is not required before entry of codes that are asterisked (*) in the table below. The asterisked codes control **operator-usable** functions.

- Enter the desired 4-digit code (Table 8-2) and press L.

2. In most cases: To terminate a Diagnostic Routine, press CLR. You may then enter another 4-digit Diagnostic Routine without re-entering **3597** since the system is still in the Diagnostic Mode.

Code Function

CHECKS OF MICRO PORTS ON U01 (PAGE SEARCH COUNTER)

- | | |
|------|---|
| 1100 | Select for display the count triggered by trailing edge of B Row Blips. |
| 1101 | Select for display the count triggered by leading edge of B Row Blips. |
| 1102 | Select for display the count triggered by trailing edge of A Row Blips. |
| 1103 | Select for display the count triggered by leading edge of A Row Blips. |
| 1104 | Select for display the Odometer Count. |
| | |
| 1119 | Display the most significant byte of selected count (Port A). |
| 1129 | Display the least significant byte of selected count (Port B). |
| 1139 | Display all eight page search status lines. |

Note
Display values shown below are for an inactive machine state after Power ON.

Bit 7	Bit 0
0 1 1 1 0 0 0 1	
1 0 0 0 0 1 0 0	
0 0 0 0 1 0 1 0	

MISCELLANEOUS

- | | |
|-------|---|
| 2001* | Limit Film Transport speed to medium only. |
| 2002* | Limit Film Transport speed to low only. |
| 2003* | Remove Film Transport speed restrictions. |
| 2011* | Force continuous display of Blip Sensor count (Ref. 2020). |
| 2012* | Force continuous display of Odometer Count (Ref. 2020). |
| 2013* | Force continuous display of blip sizes (Ref. 2020). |
| 2020* | Reset to normal from Codes 2011, 2012, and 2013 |
| 6000 | Enable access to two micro ports at the same time. |
| 6010 | Display the current Odometer Count until CLR. |
| 6125 | Display the revision level of installed EPROMs. |
| 8013 | Repeat search cycling through all frames stored in Memory Registers.
(Enter frame numbers and do MODE STEP or MODE AUTOPRINT.) |
| 8014 | Cancel 8013. |
| 8015 | Display the number of searches done. |
| 8016 | Clear the search count of 8015 from memory. |
| 8017 | Specify that an API or BPI PCB is installed. |
| 8018 | Specify that an API or BPI PCB is not installed. |
| 8024 | Set all EEPROM Parameters to their default values. |
| 8025 | Disable Film Code Reading. |
| 8026 | Enable Film Code Reading. |
| 8031 | Disable the Film Transport. |
| 8032 | Enable the Film Transport. |
| 8033 | Disable the Reader-Printer command logic. |
| 8034 | Enable the Reader-Printer command logic. |
| 8038 | Disable 1 MC Roll number and mode. |

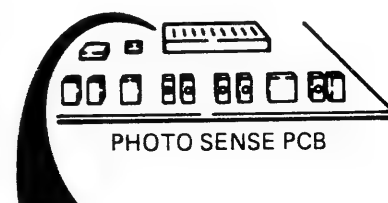
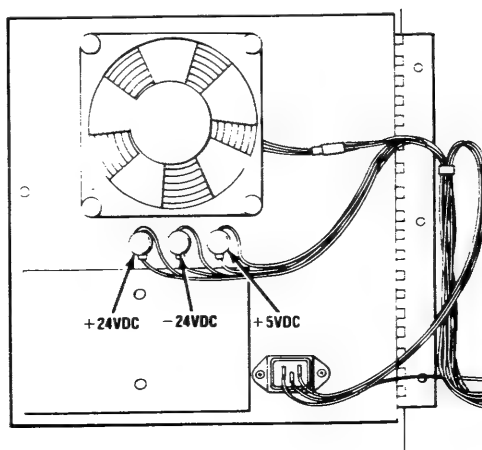
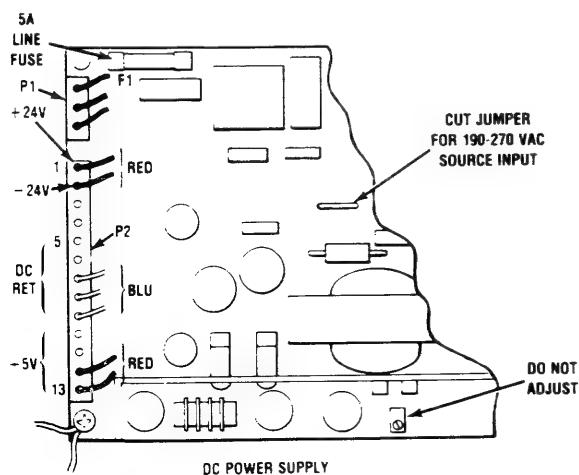
8-4. POWER SUPPLY TROUBLE ANALYSIS

Table 8-3.1

Fuse	Value	Circuit	Functions
F1 (Line)	5A	Input AC	Total machine electrical functions.
F1	4A	+ 5 vdc	All M-656 Micro and Logic functions.
F2	1A	- 24 vdc	\pm 24 vdc to regulators on Page Search and ABI or BPI PWB's.
F3	1A	+ 24 vdc	\pm 24 vdc to regulators on Page Search and ABI or BPI PWB's.

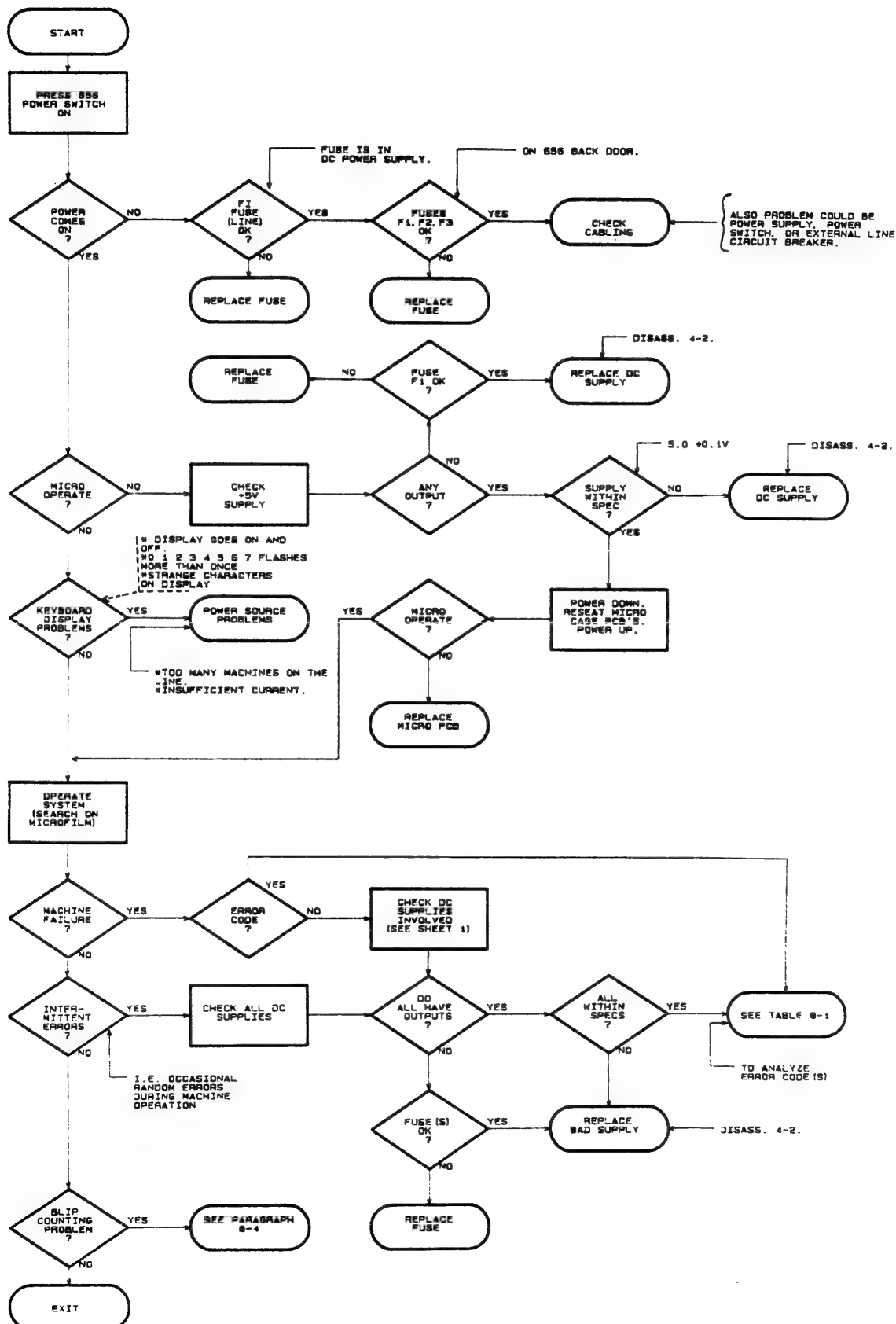
Table 8-3.2

VDC Supplies	M-656 Location	Functions Affected
+ 5 \pm 0.1 vdc	Inside Rear Door	Micro system control logic power. Also filtered and regulated on Photo Sense PWB to produce 2.5 to 2.8 vdc for Blip Lamps.
+ 24 \pm 1.2 vdc	Inside Rear Door	Supplies for regulators on Page Search PWB that provide + dc power to blip sensing and counting circuits.
-24 \pm 1.2 vdc	Inside Rear Door	Supplies for regulators on Page Search PWB that provide - dc power to blip sensing and counting circuits.
+ 5 vdc P/S	Regulator on Page Search PWB	Supply for Blip Sensors and Photo Sense Amplifier PWB. Required for Blip Sensing.
-5 vdc P/S	Regulator on Page Search PWB	dc Bias Level for Blip Sensor Input Search PWB channels. Required for Blip Sensing.
-6 vdc	Regulator and filter on Page Search PWB	Used by Comparators on Page Search PWB. Required for accurate Blip counting.
+ 12 vdc	Regulator on Page Search PWB	Used by Op Amps and Analog Switch on Page Search PWB. Required for accurate Blip counting.
-12 vdc	Regulator on Page Search PWB	Used by Op Amps and Analog Switch on Page Search PWB. Required for accurate Blip counting.

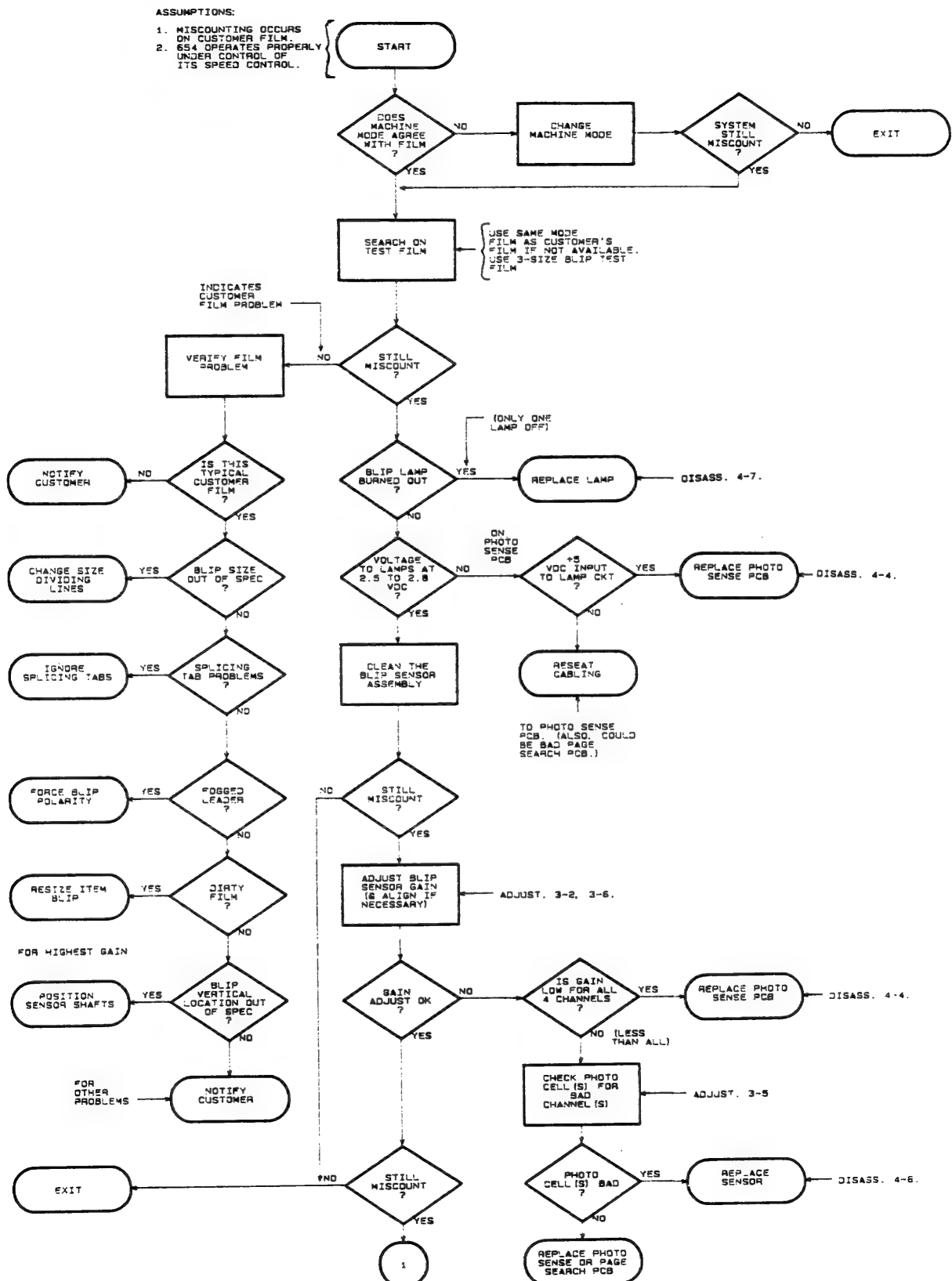


PIN 9 = -5V
 PIN 1 = +5V
 PIN 8 = 5V
 PIN 5 = P/S GND
 ACROSS C1 = 2.5 TO 2.8 VDC

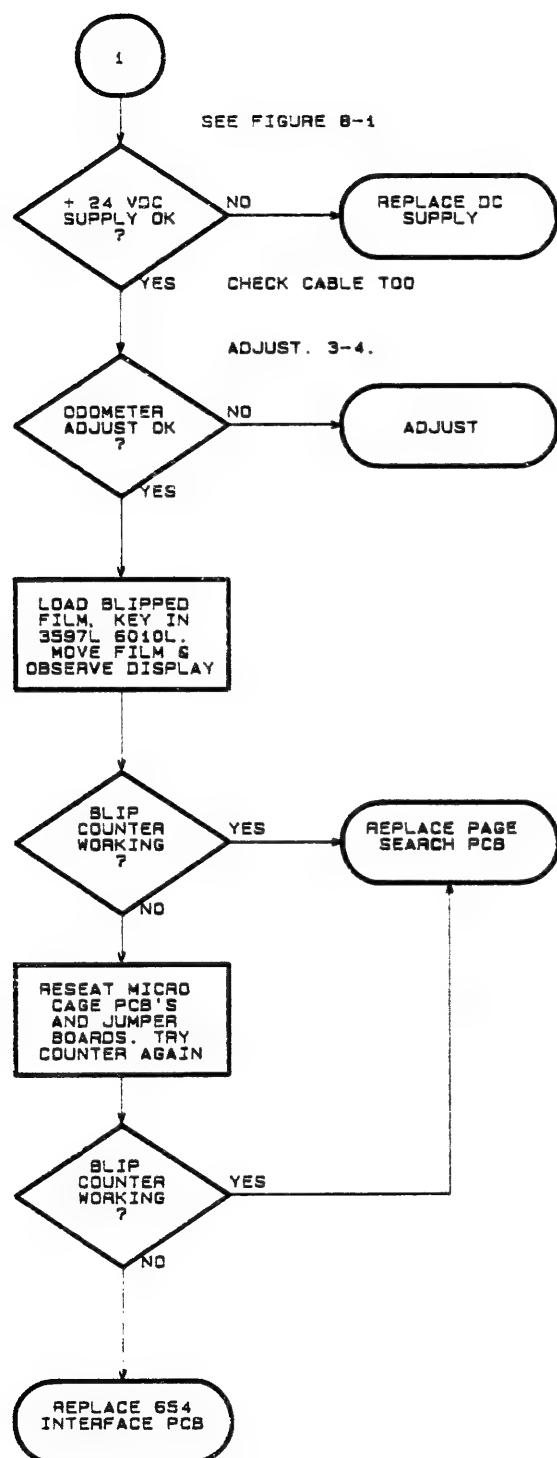
8-5. POWER SUPPLY TROUBLE ANALYSIS FLOWCHART



8-6. PAGE SEARCH COUNTING PROBLEMS



8-6. PAGE SEARCH COUNTING PROBLEMS (Continued)



8-7. CHECKLIST

AUTO-THREADING

- Problem:** Blip Sensors miss Kodak Brand ANSI film on the first auto-thread attempt.
- Cause:** Film orientation is different for Kodak film cartridges.
- Correction:**
1. Have the operator strike the film reel on a flat surface to reorient film.
 2. Increase the spring tension of the "butterfly wings" (Guide I and Guide II).

BLIP SENSING

- Problem:** No Blip Sensing.
- Cause:** Miscount registered in Keyboard Display during search.
- Correction:**
1. Do Adjustment 3-2. Blip Sensor Assembly Position, page 3-1.
 2. Do Adjustment 3-5. Blip Sensor Position, page 3-7.
 3. Do Adjustment 3-7. Blip Lamp Voltage, page 3-12.
 4. Replace Blip Lamps (Disassembly 4.7. Blip Lamps, page 4-4).

FILM SCANNING

- Problem:** Miscounting.
- Cause:**
1. 2.5 mil ANSI film mistracks after loading.
 2. Film is mistracking because of loose bearings in the Spring Loaded Film Guide Roller (M-654 Section 5, Item 55). Machines prior to S/N 5404201.
 3. Unable to adjust the amplitude of the blip signals to a high enough level to count accurately or the Blip Photo Sensor Gain Adjustment 3-7 does not stay at the initial amplitude.

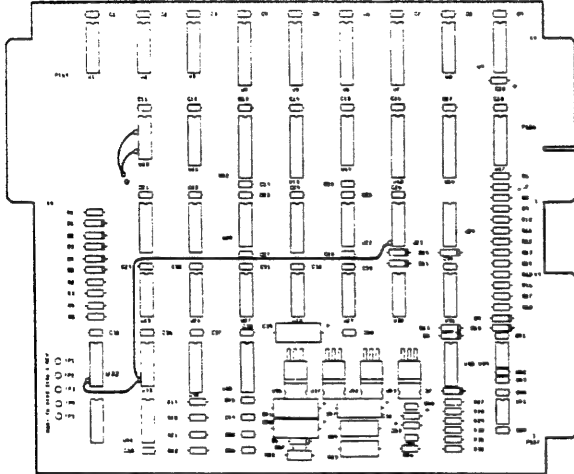
- a. Low blip lamp voltage due to misadjusted 5 vdc.
- b. Low blip lamp voltage due to resistance in lamp harness.
- c. Slightly conductive dirt on blip sensor traces.
- d. Defective Blip Lamp or misadjusted Blip Lamp position.
- e. High resistance in +5 vdc Fuse Holder.

- Correction:**
1.
 - a. Install a new Spring Loaded Film Guide Roller having "O" Rings around the circumference.
 - b. Do Adjustment 3-5. Encoder Disc Roller, page 3-5.
 2. Install Spring Loaded Film Guide Roller (DZ-6560-2030-9) having "pinned" bearing.
 3.
 - a. Do Adjustment 3-7. Blip Lamp Voltage, page 3-12.
 - b. Remove the heat shrink tubing, solder the wires to the crimp connection, and tape.
 - c. Clean the Blip Sensor Assembly with compressed air every 50,000 cycles or when low or missing signals occur. Remove the sensor to properly clean.
 - d. Replace or readjust the position of the Blip Lamps.
 - e. Install Fuse Block Kit, IFC 7530- .

- Problem:** No count in multi-level modes.

- Cause:**
1. Parameter 110 not set to a value of 0001.
 2. The EPROM level is lower than 0.59. (To check the firmware version, enter 3597 L 6125L.)
 3. The Page Search PCB not P/N 78-8049-3613-2 or an updated P/N 78-8003-3136-1. The updated PCB has wire jumpers as shown in the drawing below.

- Correction:** Set Parameter 110 to a value of 0001. This tells the program that the new Page Search PCB has been installed.



Updated 78-8003-3136-1 Page Search PCB

Parameter Change Procedure

- Problem:** Parameters are changed from default values but the system does not react to the change.
- Correction:** After changing parameters with the Write/Disable Switch in the Write (down) position, switch the M-7530 and M-656 OFF and back ON, then place the Write Switch in the Disable (up) position.

POWER ON

- Problem:** Page Search is inoperative, Keyboard Display is blank but the cooling fan runs.
- Cause:** No +5vdc from M-656 Power Supply PWA.
- Correction:** Replace Line Fuse (F1).

Error Codes 50 and 52

- Problem:** After installing an M-656 Page Search on an M-7530 Reader-Printer, Error Code 50 or Error Code 52 displays following a print cycle.
- Cause:** The new PROM for the M-7530 Logic Board (78-8051-9741-1) shipped with the M-656 was not installed.
- Correction:** Install the new PROM on the M-7530 Logic Board. Refer to page 6, Step 5 of the M-656 Installation Instruction and the instructions included with the PROM. This PROM must be installed on all M-7530 Reader-Printers when Page Search is added. It is not installed in M-7540 Reader-Printers.

Error Codes 96 and 98

- Problem:** Error Code 96 or 98 occurs after inputting a number. The Keyboard is probably inactive after this.
- Cause:** Poor ground contact. Resistance measured between TP5 on the Page Search PCB and the Chassis should read a short.
- Correction:** Measure for a good ground from P2 Pin 6 on the M-656 Power Supply to Chassis. Also measure from TP5 to Chassis. For now the, solution is to run a wire from the M-656 Chassis to the M-7530 Chassis.

Error Codes 400 Through 499

- Problem:** Image position registration is unacceptable.
- Cause:** M-654 coated too long (reverse coating). The M-656 compares the odometer counts needed to reach the next blip to the odometer counts actually sensed. The number of odometer counts exceeded the maximum allowable

coasting distance determined by
Parameter 007.

Correction: Adjust the M-654 Brake Solenoid and Brake Disk. The last two digits of the Error Code indicate the amount of coasting that exceeds the maximum allowable. If image position registration is acceptable, the default value of Parameters 007 can be increased to eliminate the code.

Error Codes 500 Through 599

Problem: Image position registration is unacceptable.

Cause: M-654 coasted too long (forward coasting). The M-656 compares the odometer counts needed to reach the next blip to the odometer counts actually sensed. The number of odometer counts exceeded the maximum allowable coasting distance determined by Parameter 007.

Correction: Adjust the M-654 Brake Solenoid and Brake Disk. The last two digits of the Error Code indicate the amount of coasting that exceeds the maximum allowable. If image position registration is acceptable, the default value of Parameters 007 can be increased to eliminate the code.

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

Correction: _____

Problem: _____

Cause: _____

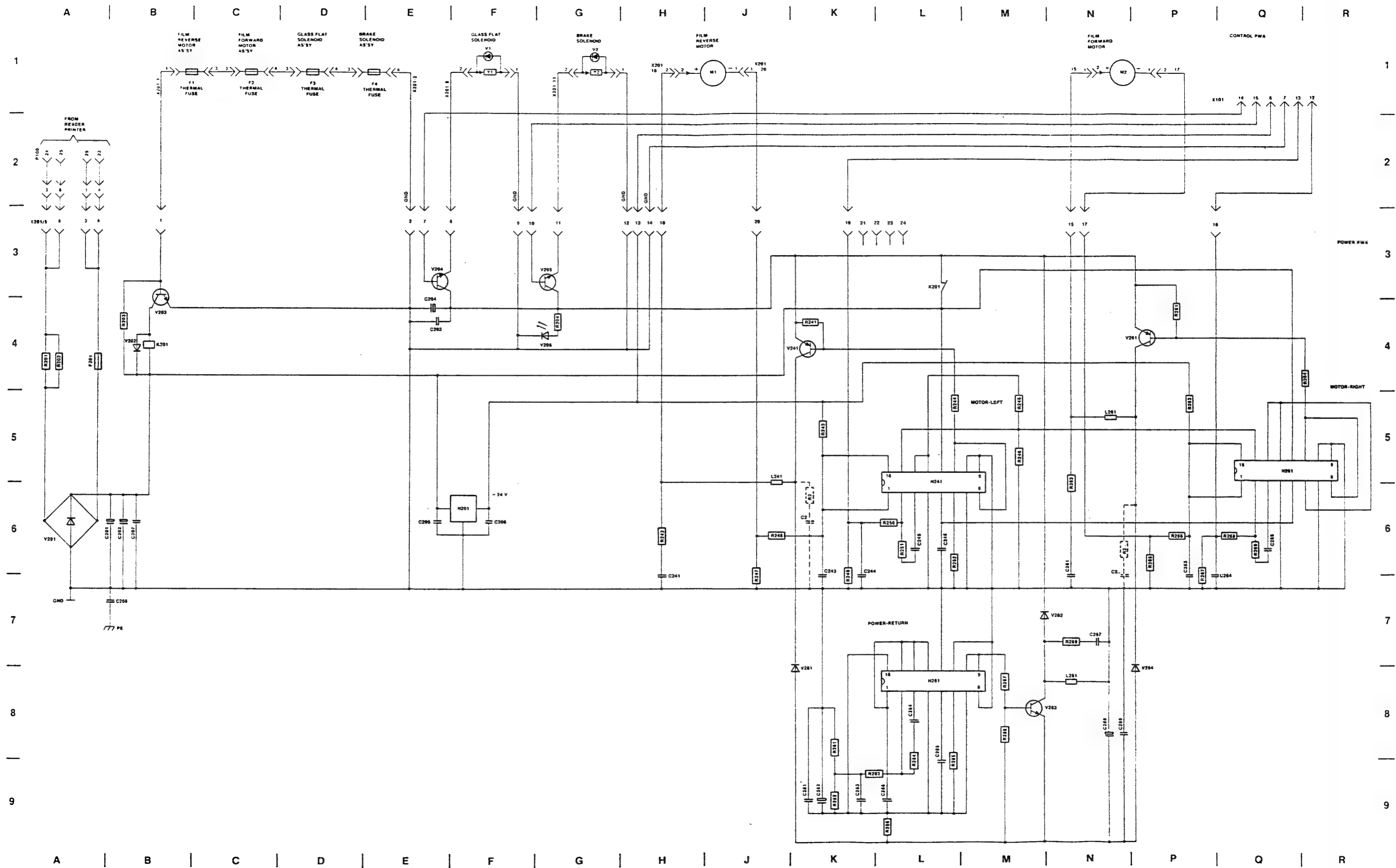
Correction: _____

Problem: _____

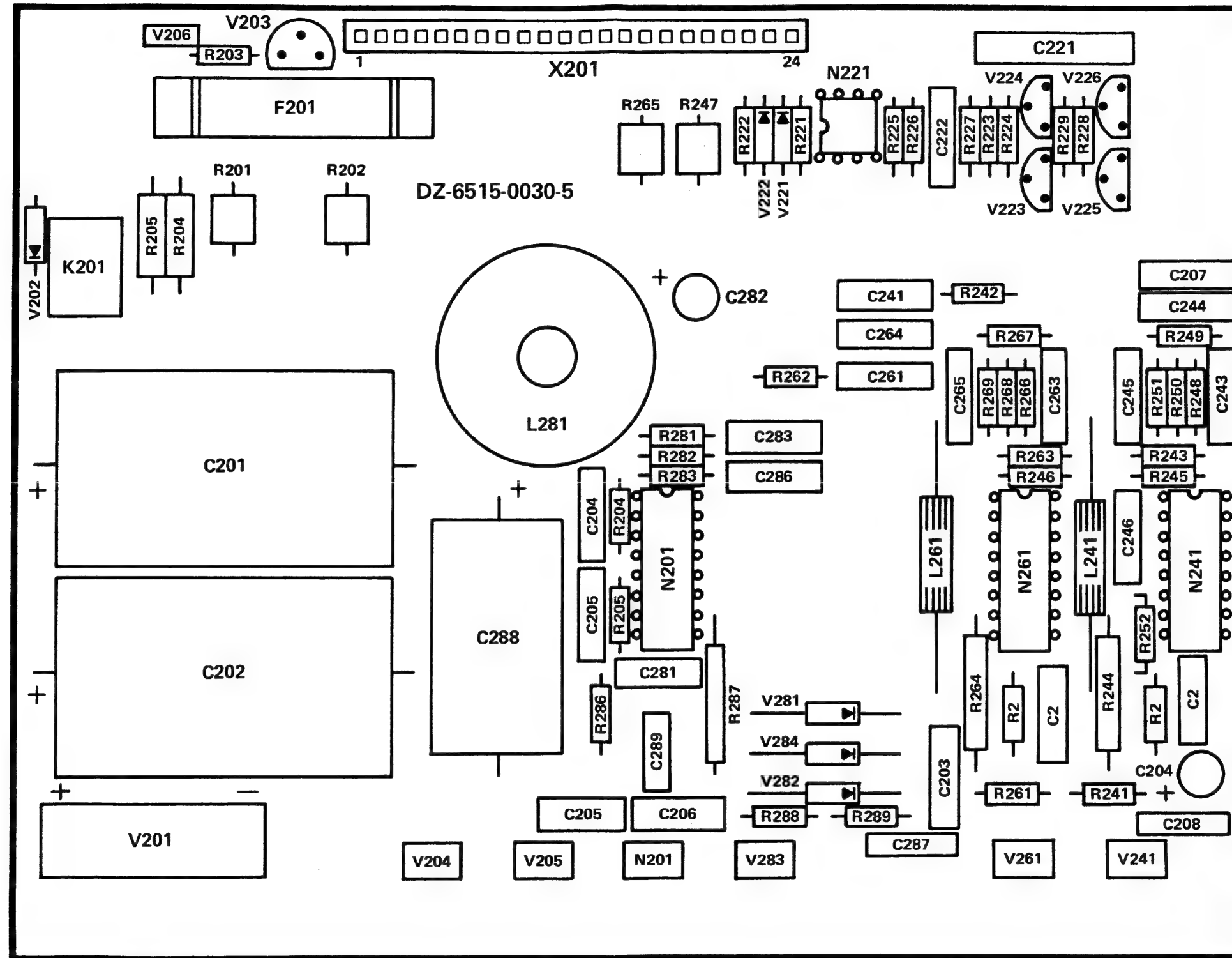
Cause: _____

Correction: _____

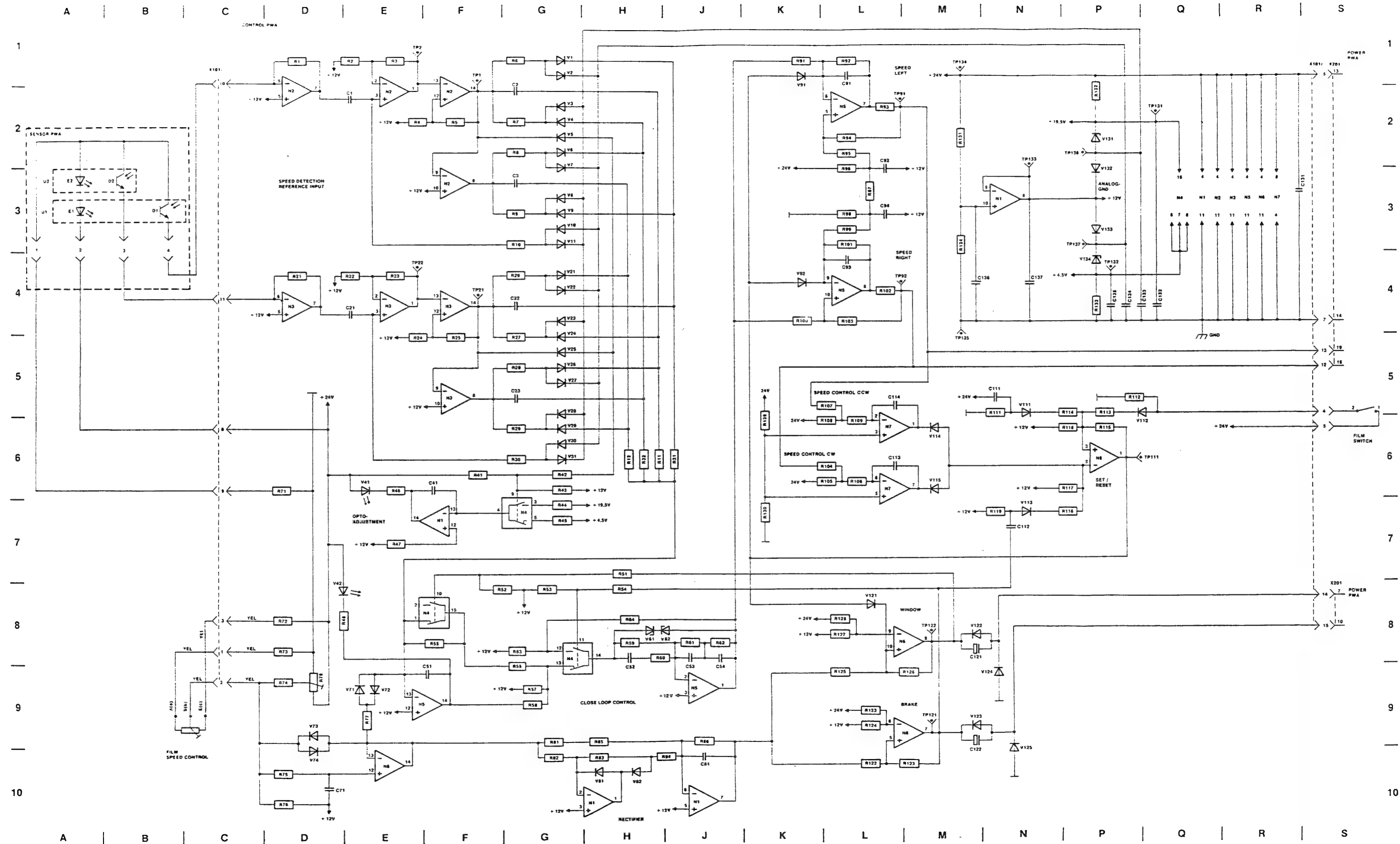
7-1. POWER CIRCUIT



M-652 POWER PWA

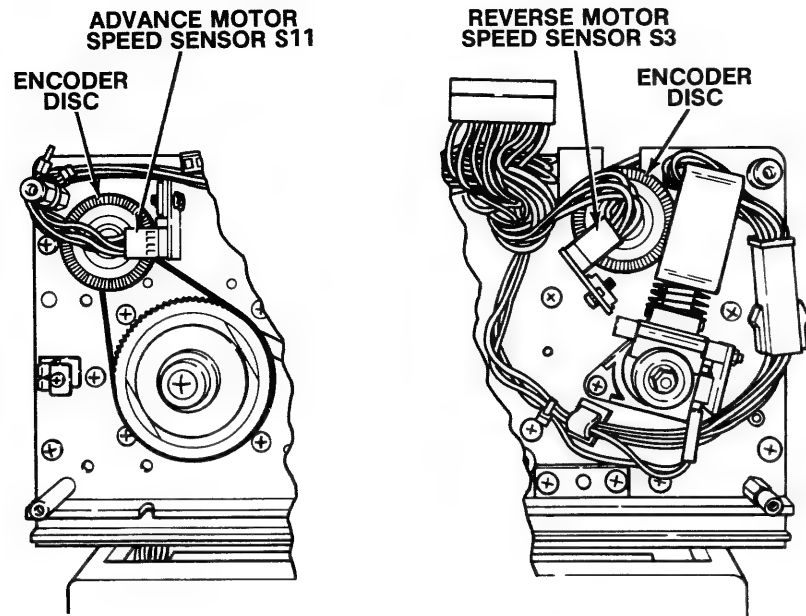


7-2. CONTROL CIRCUIT

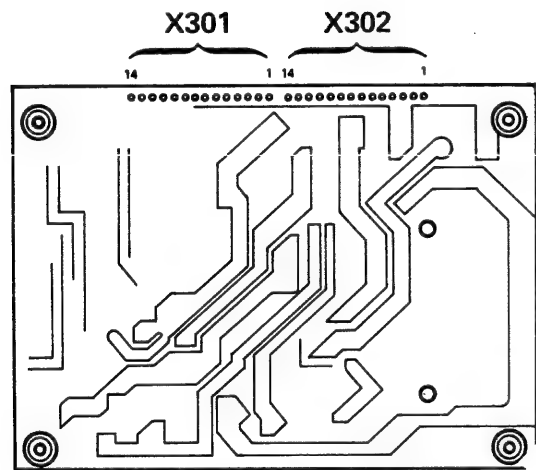


A | B | C | D | E | F | G | H | I | J

1



2

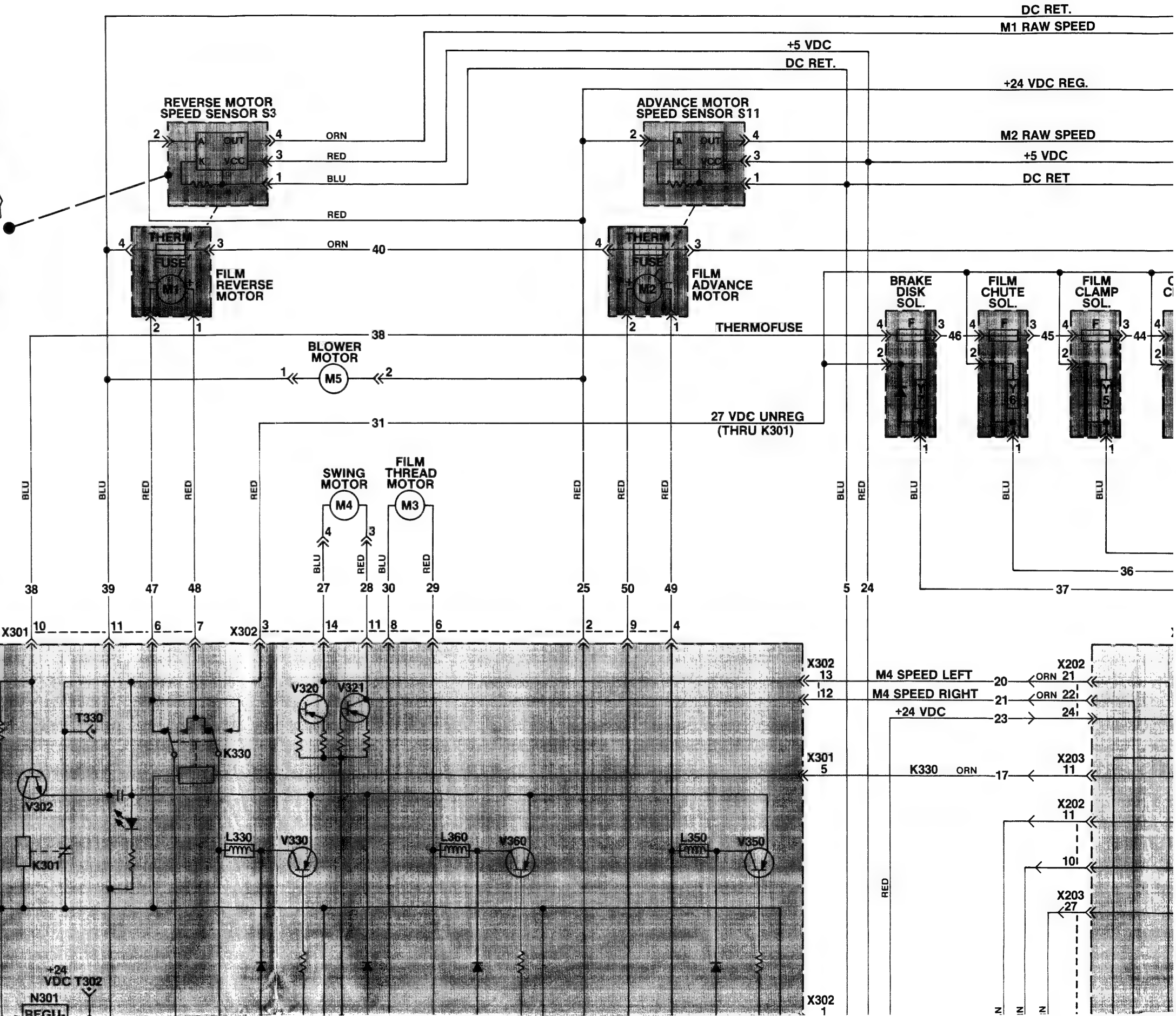


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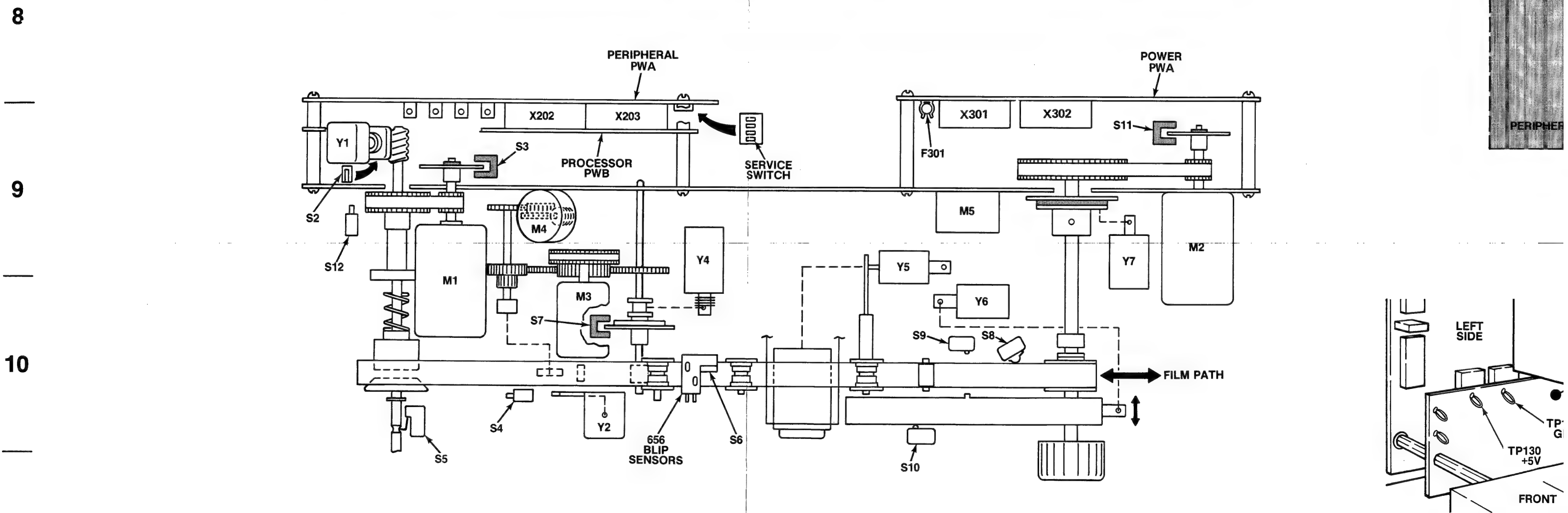
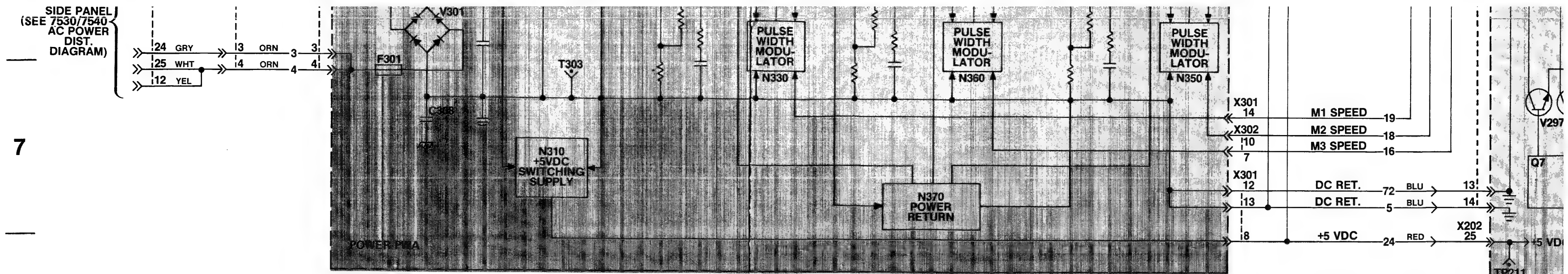
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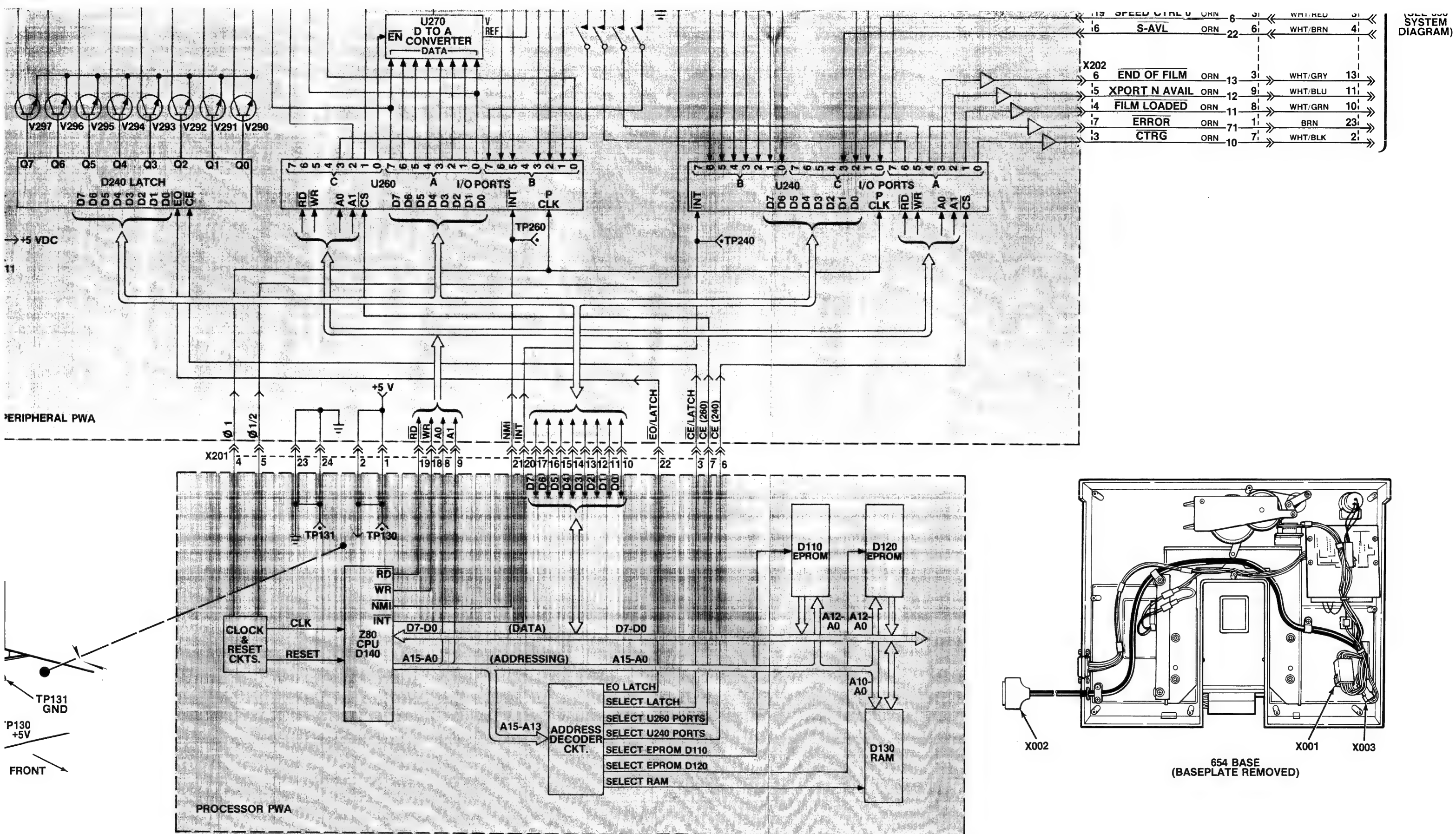
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6









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J

K

L

M

N

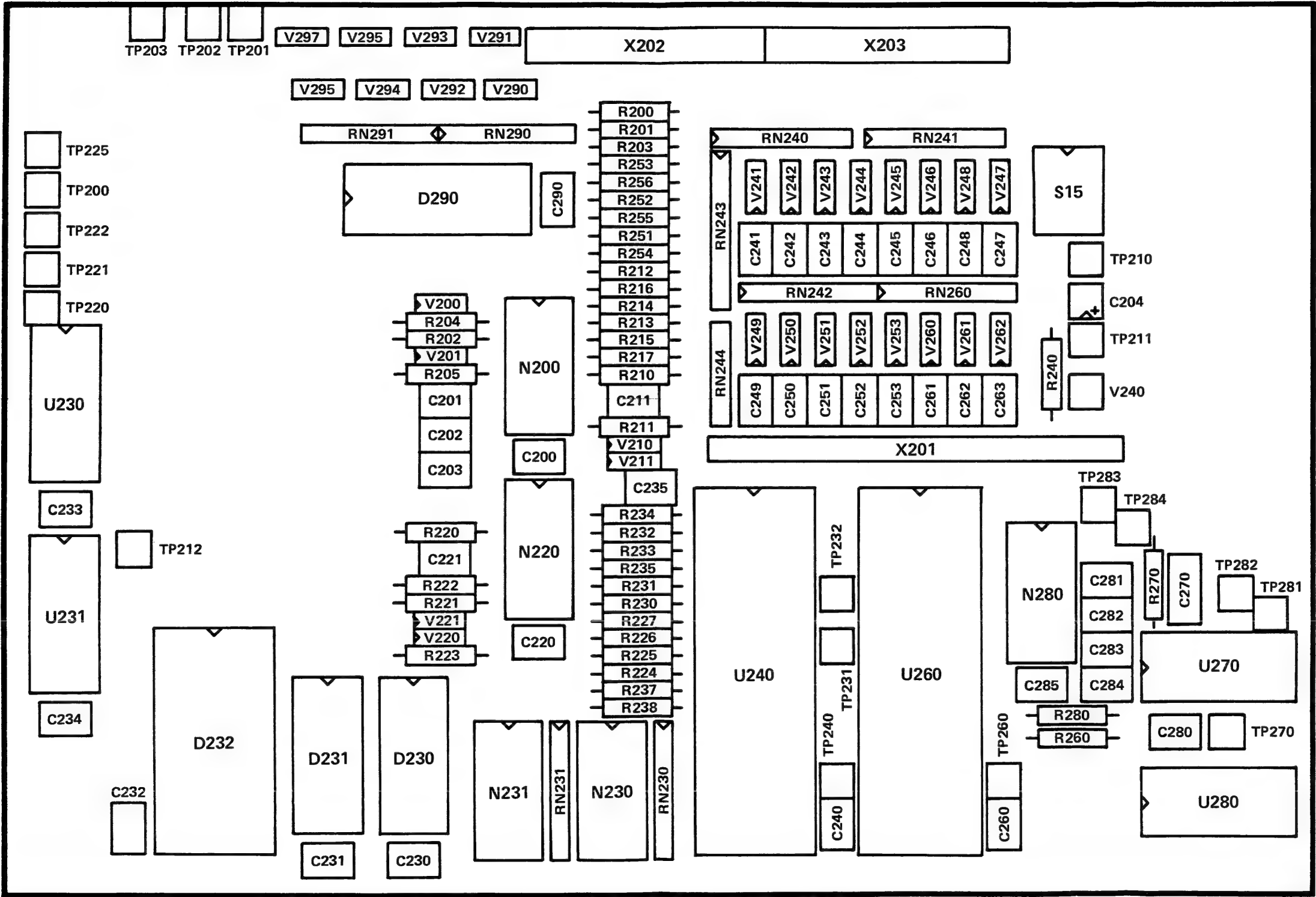
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Q

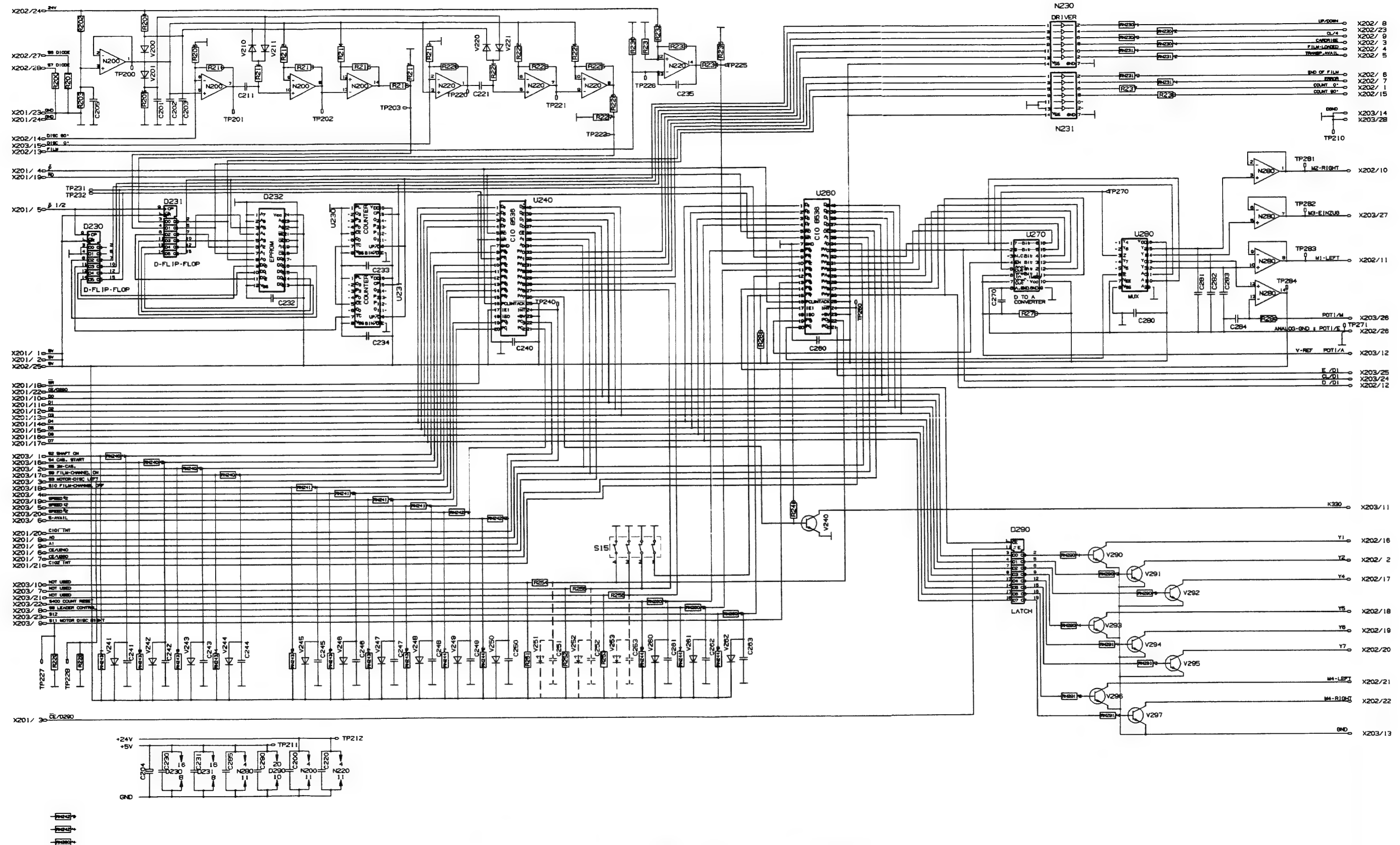
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S

7-1. PERIPHERAL PWA

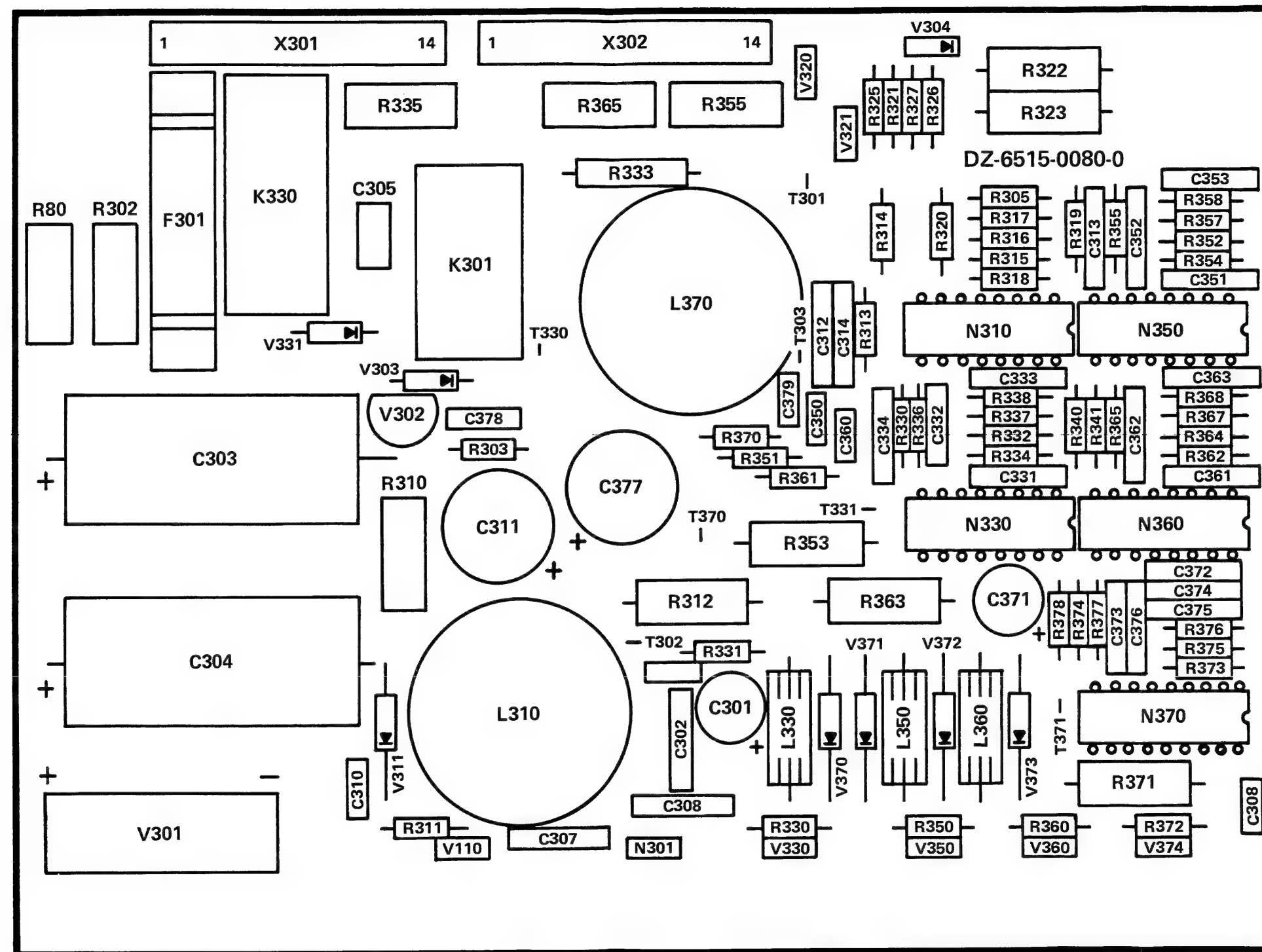


M-654 PERIPHERAL PWA

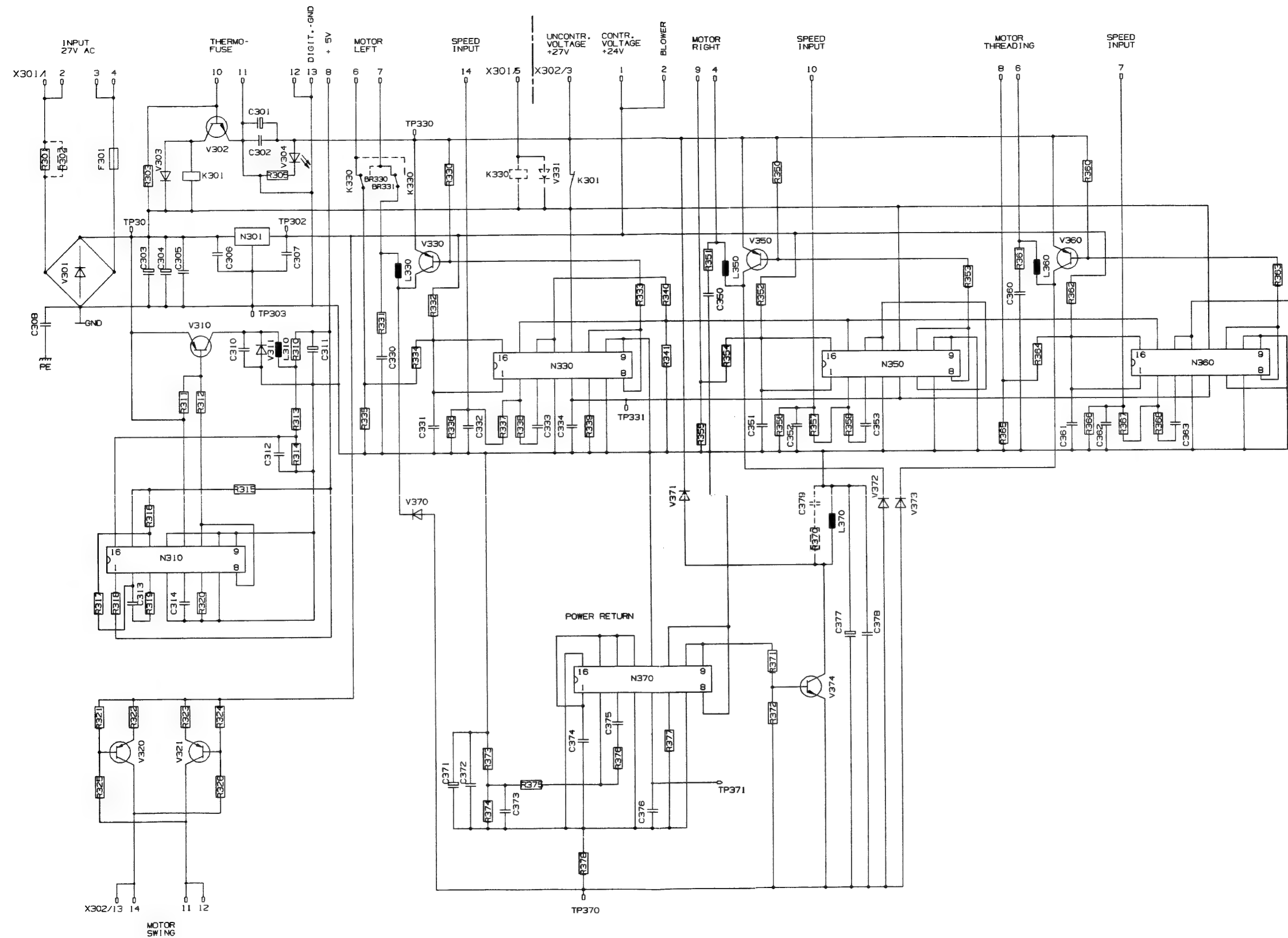


M-654 PERIPHERAL PWA

7-2. POWER PWA

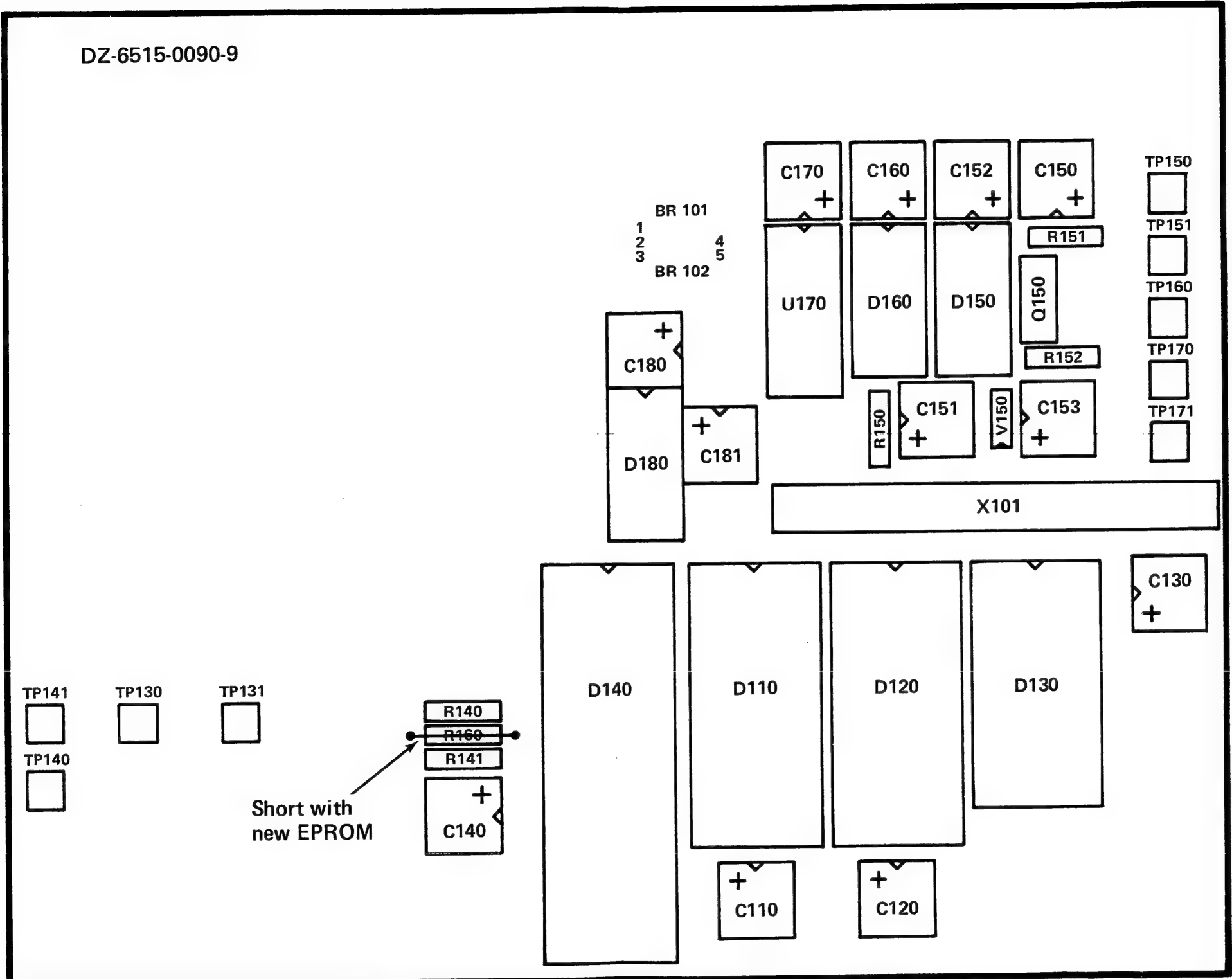


M-654 POWER PWA

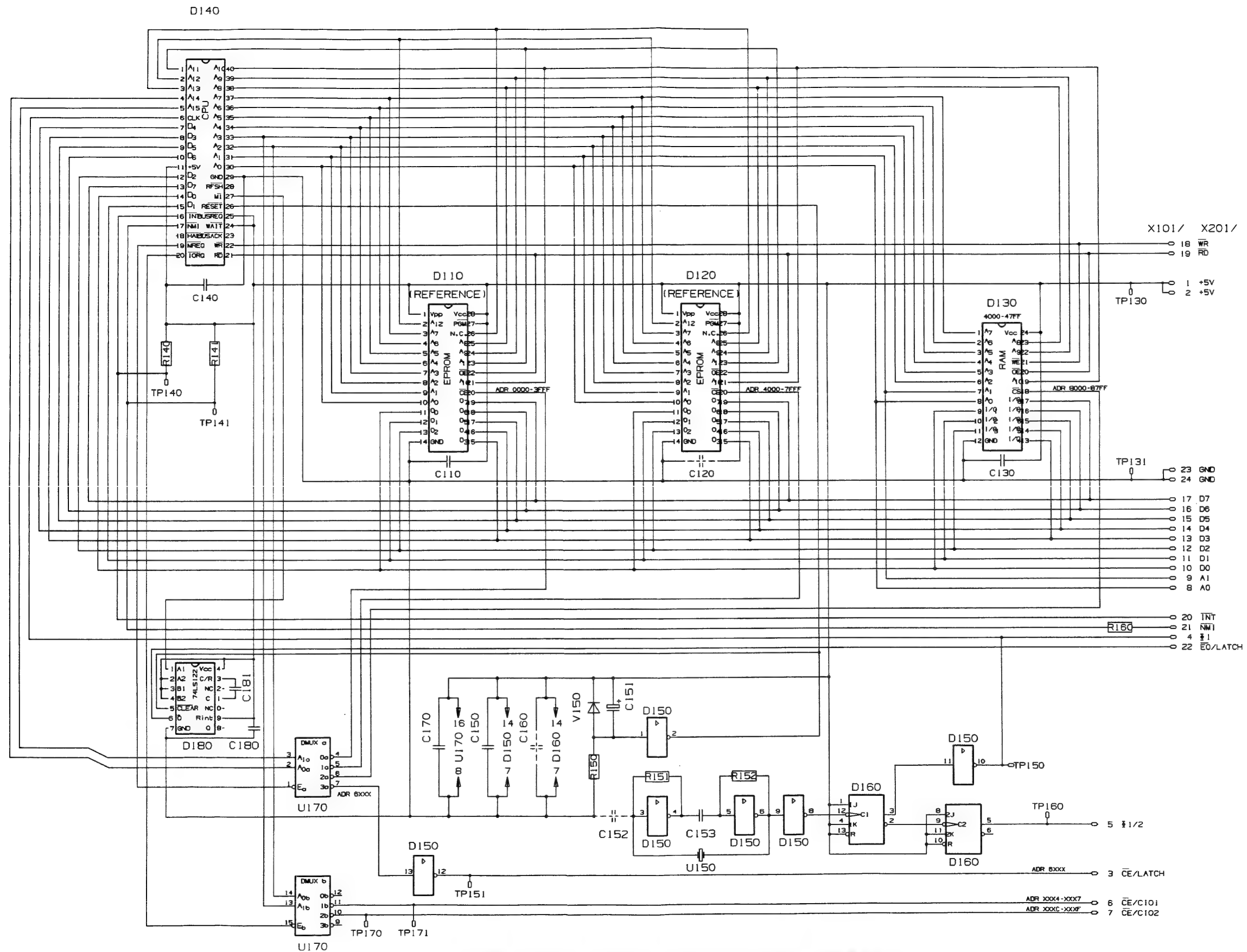


M-654 POWER PWA

7-3. PROCESSOR PWA



M-654 PROCESSOR PWA



M-654 PROCESSOR PWA

A

B

C

D

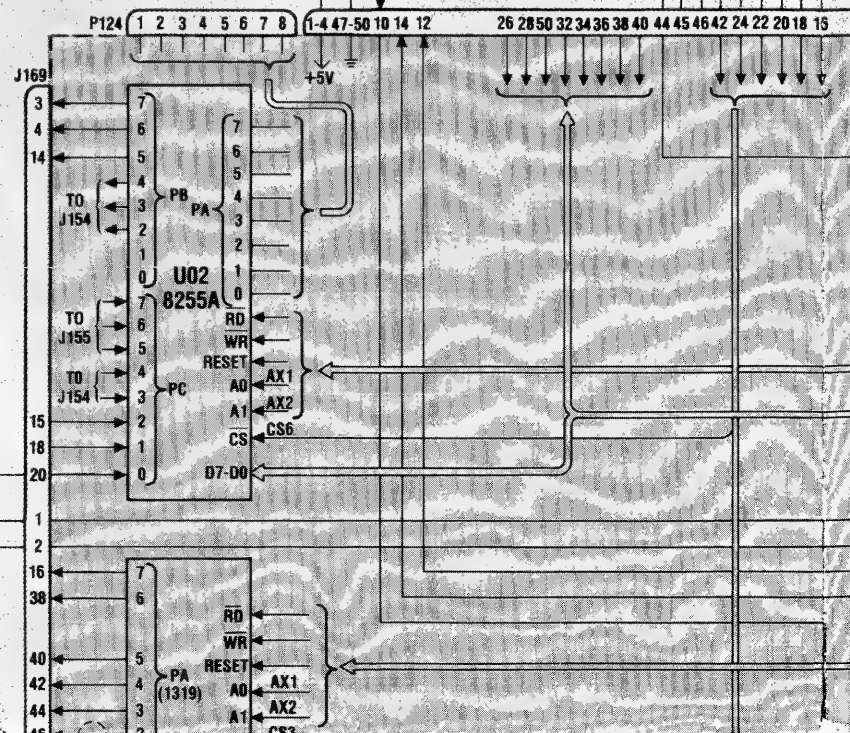
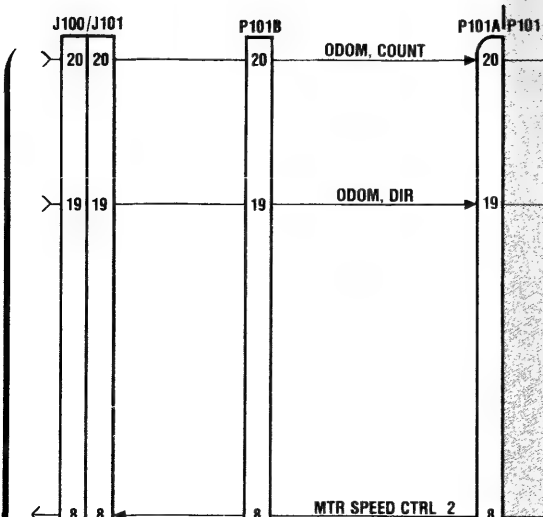
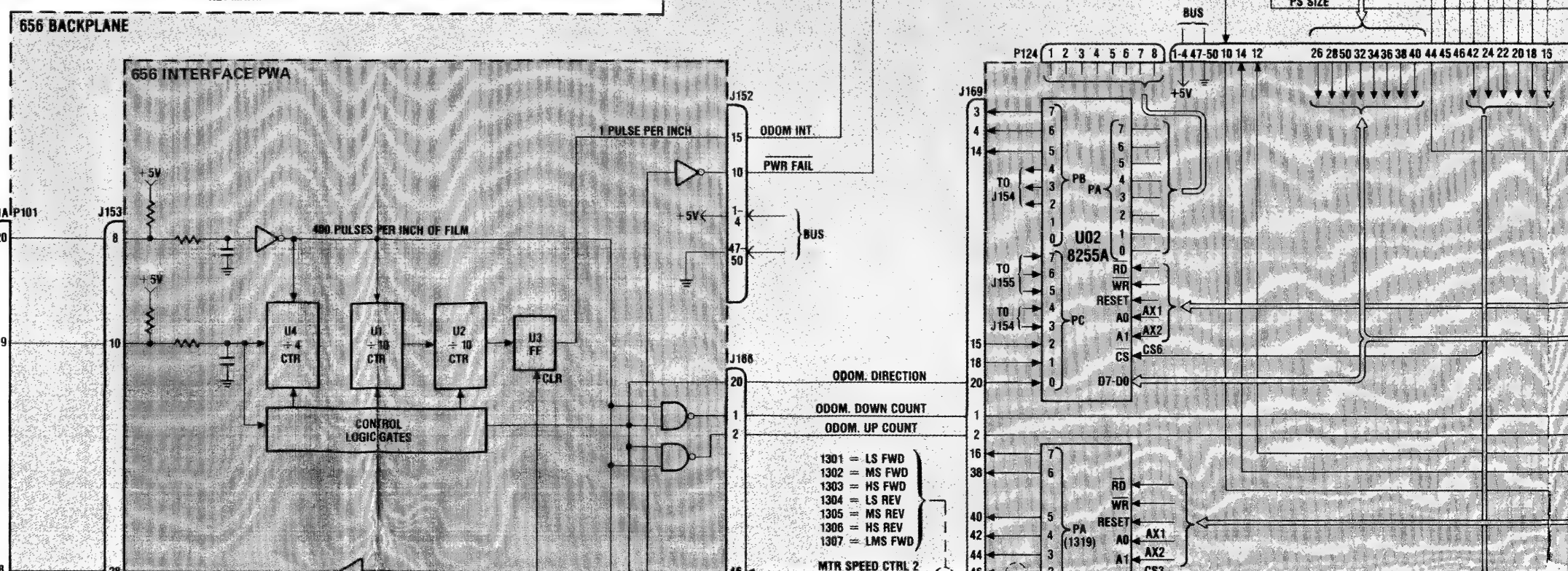
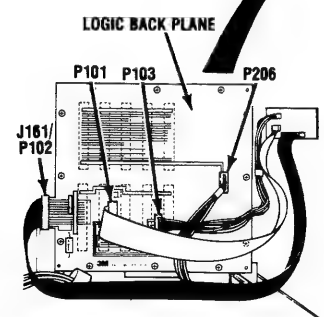
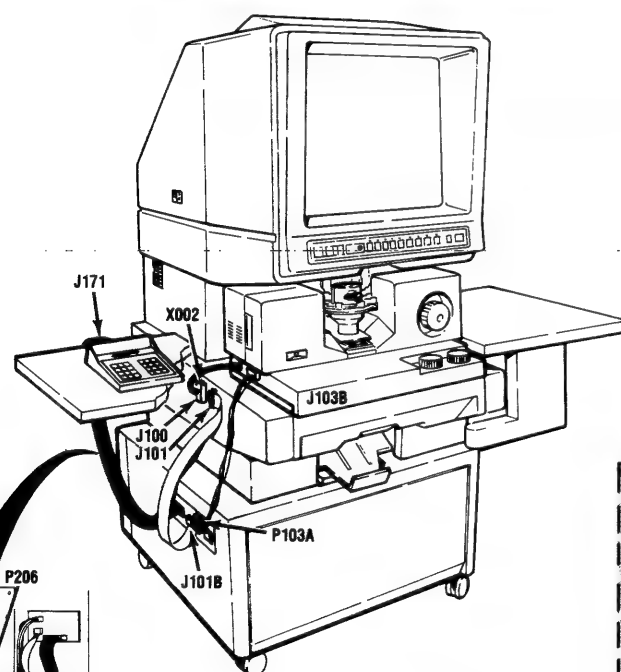
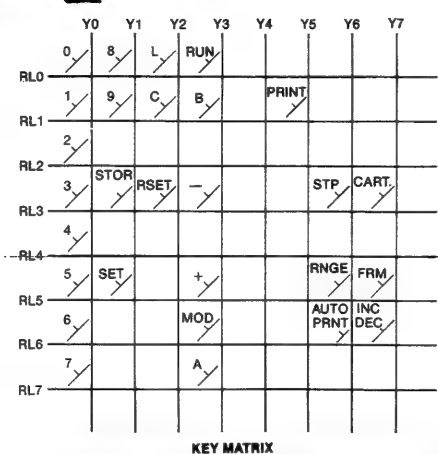
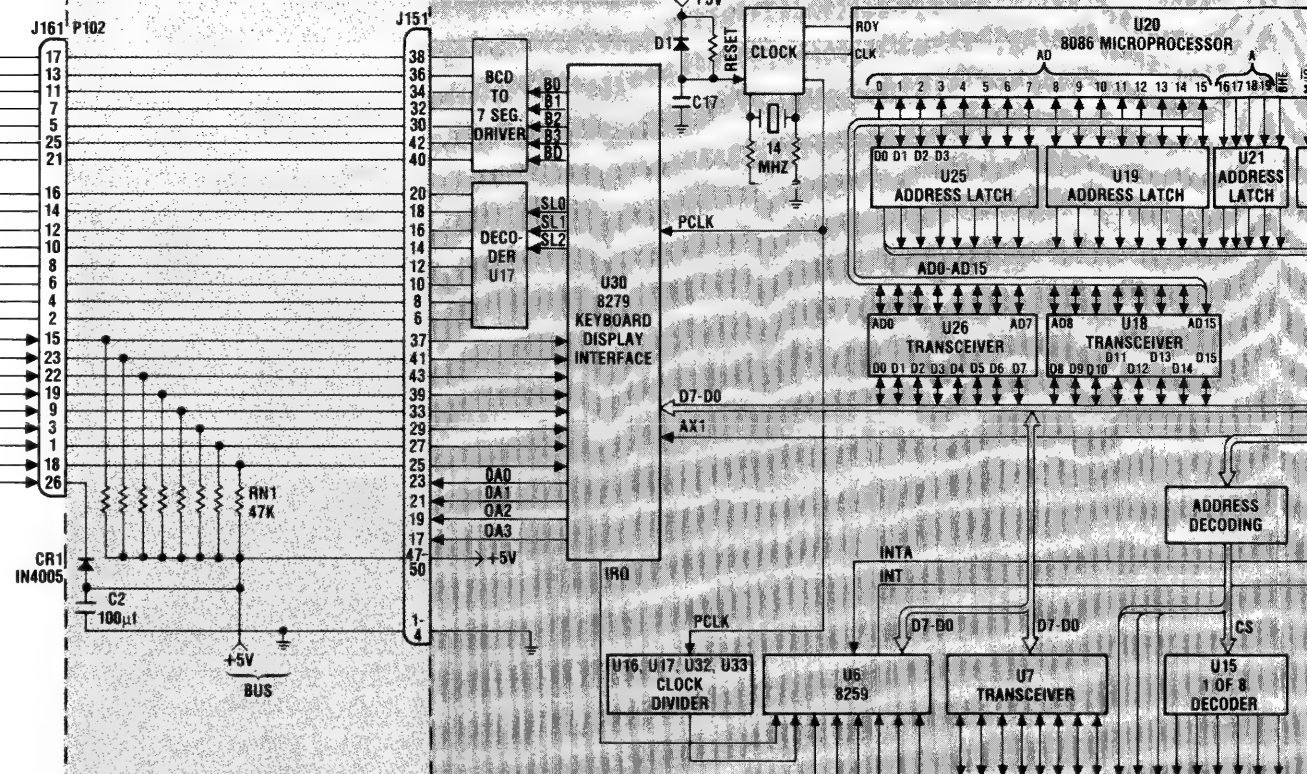
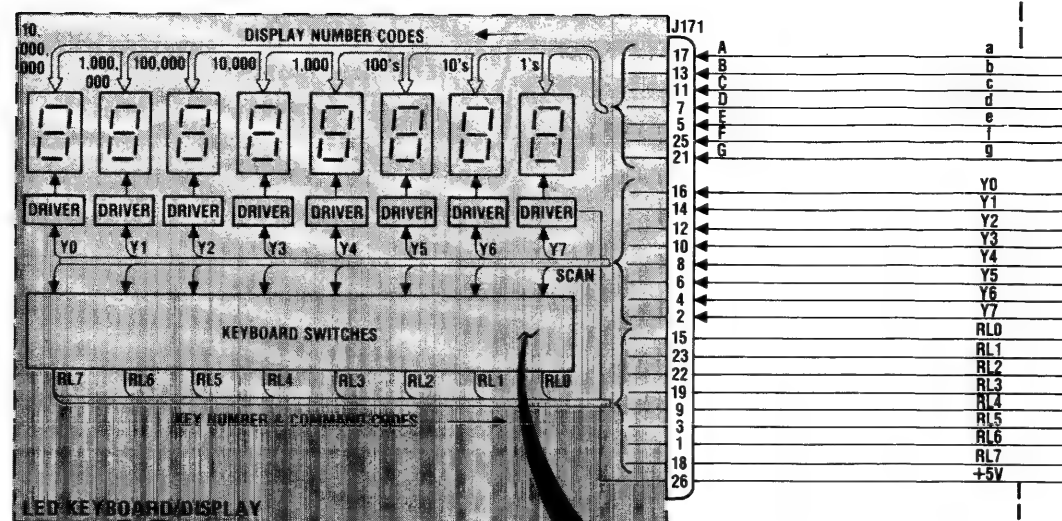
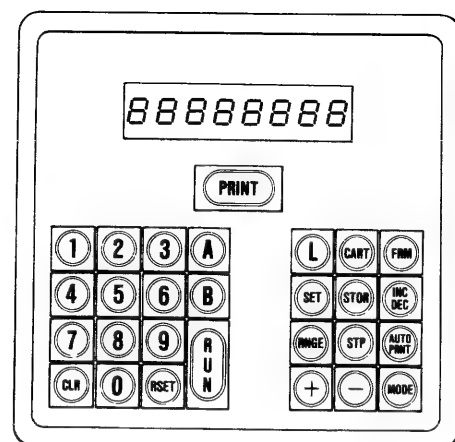
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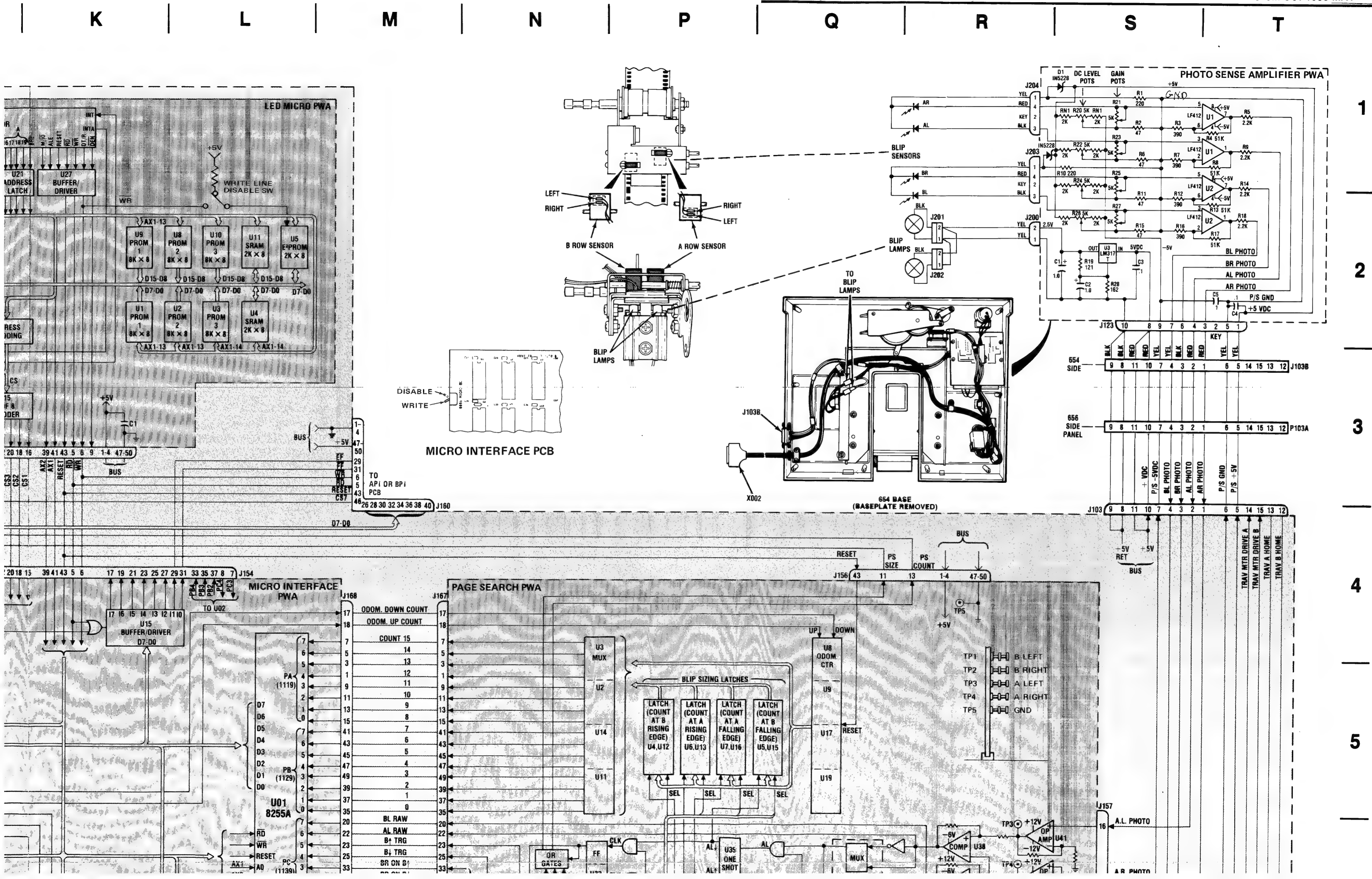
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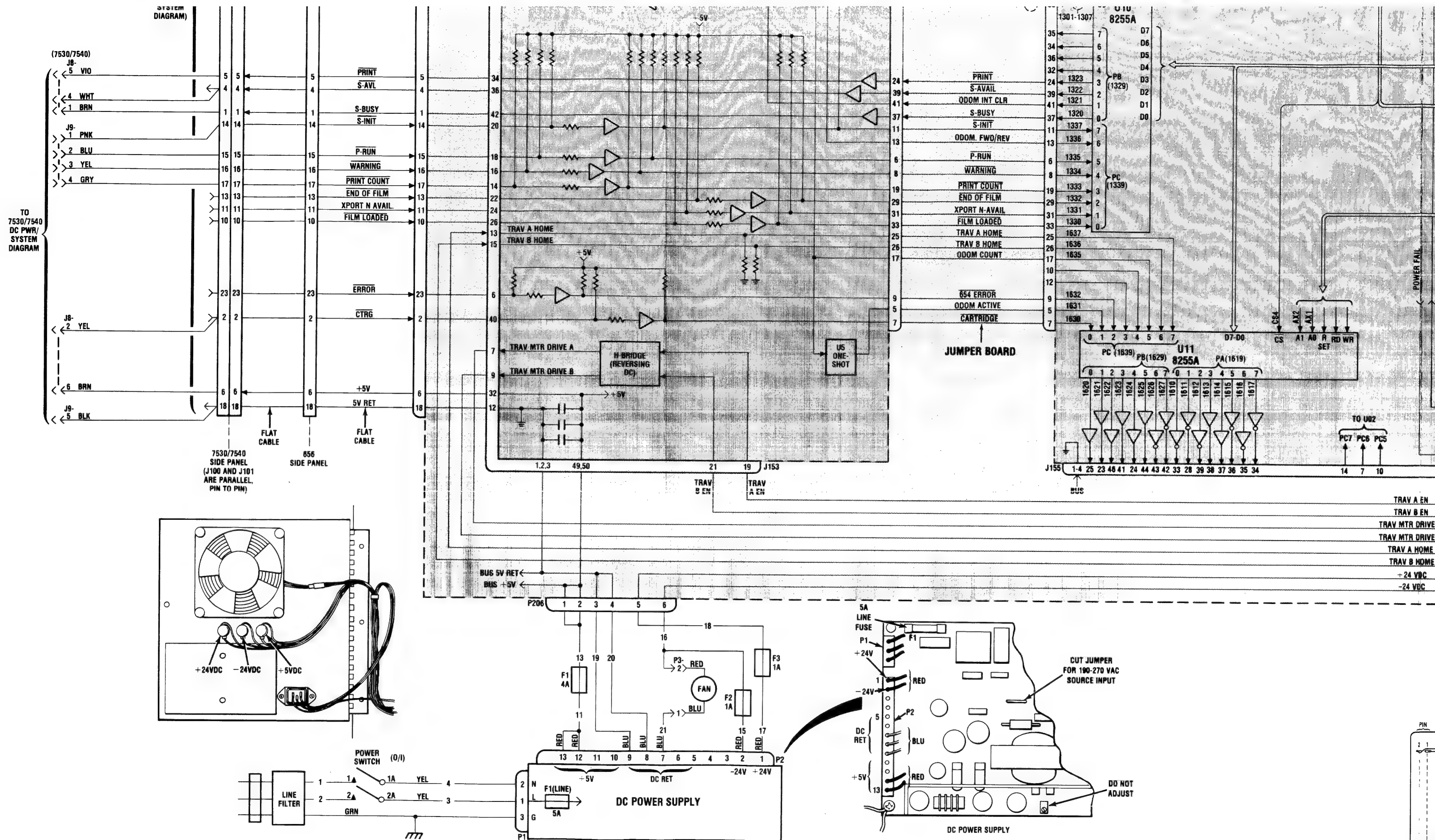
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A

B

C

D

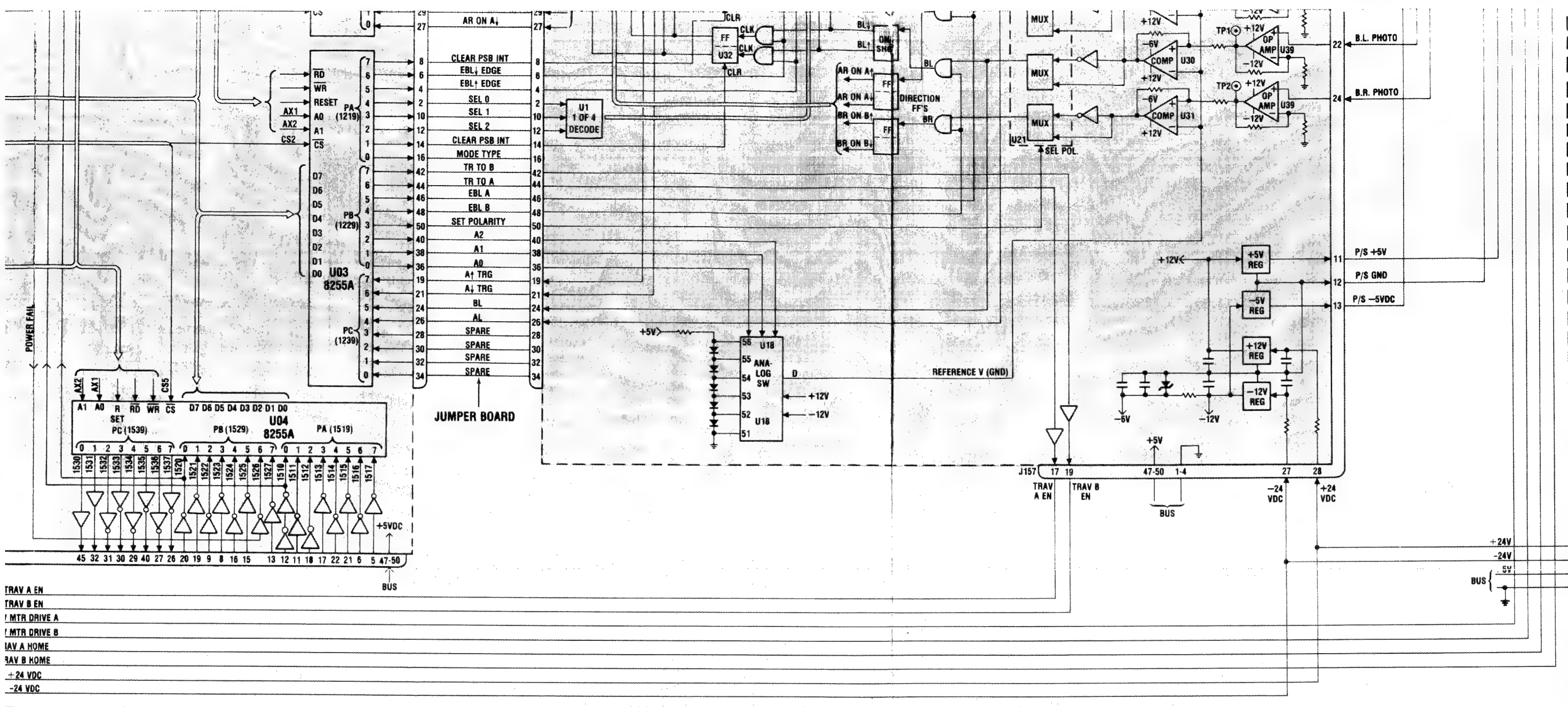
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G

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J



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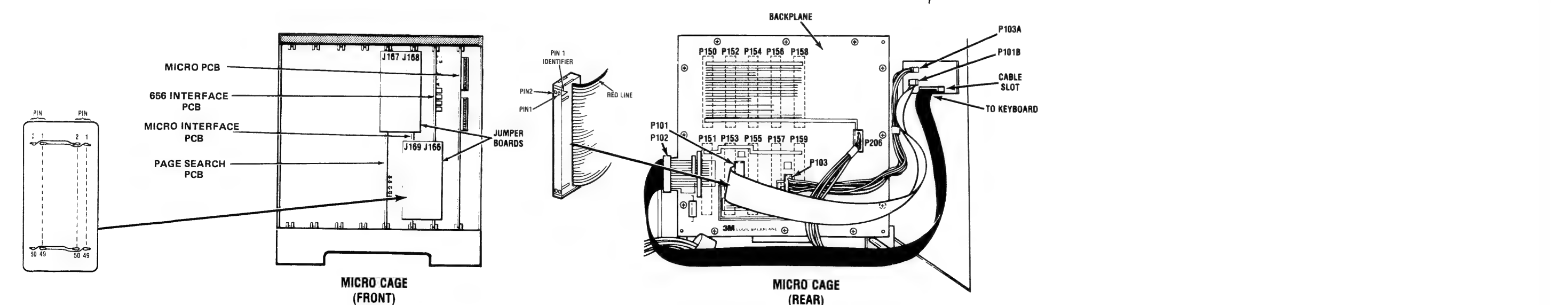
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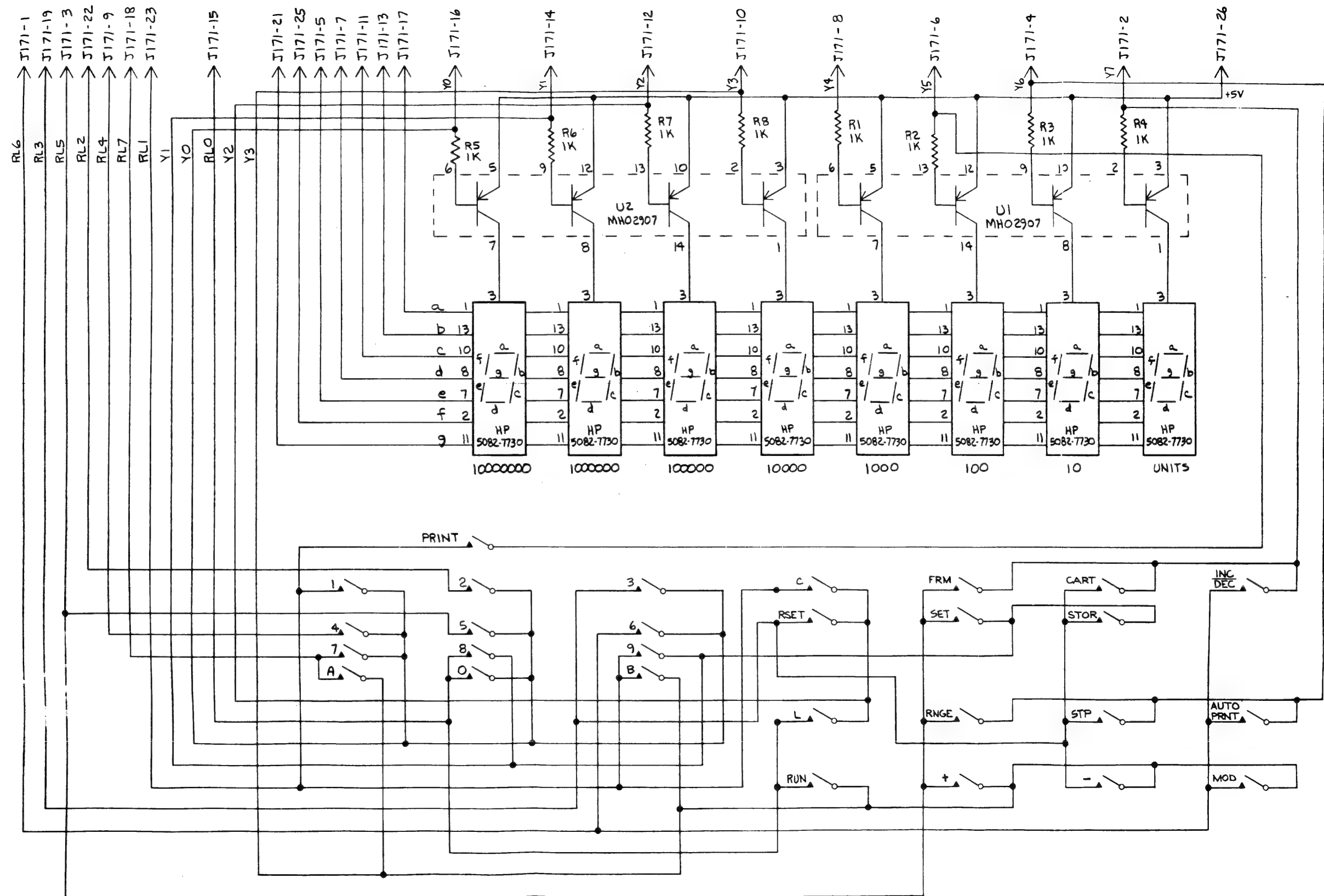
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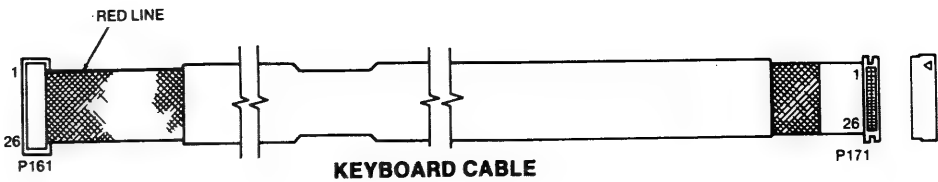


K | L | M | N | P | Q | R | S | T

7-1. LED Page Search Keyboard PCB
(Sheet 1 of 2)

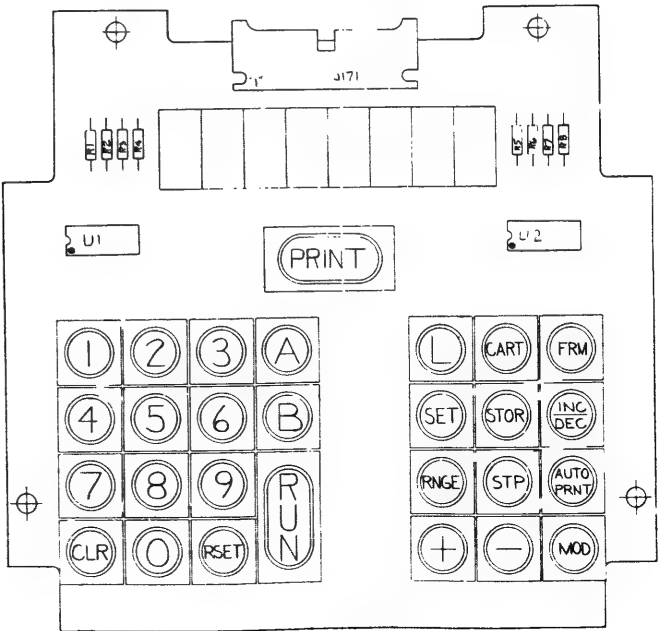


7-1. LED Page Search Keyboard PCB (Cont).
(Sheet 2 of 2)

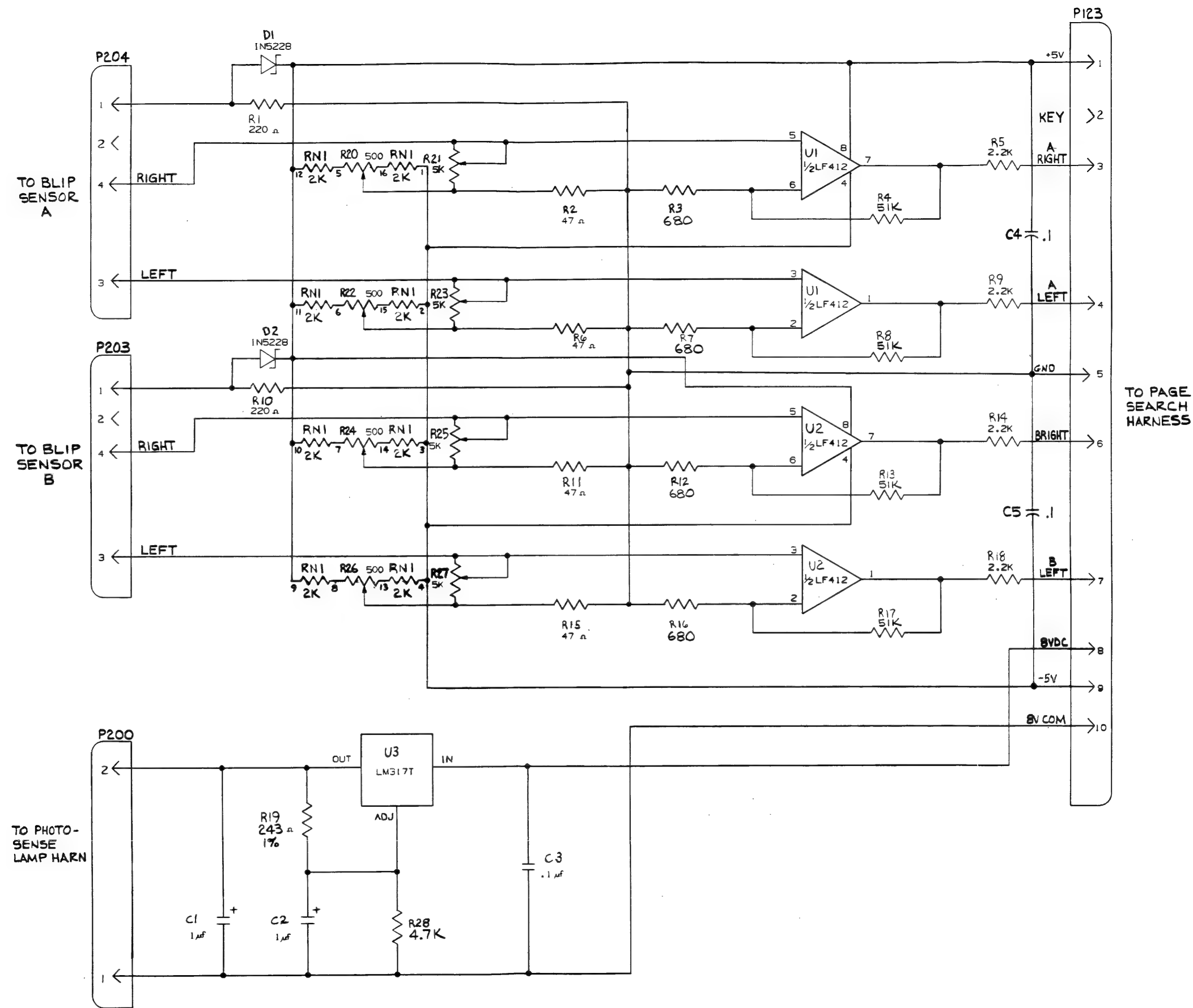


	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
RL0	0	8	L	RUN				
RL1	1	9	C	B	PRINT			
RL2	2							
RL3	3	STOR	RSET	-		STP	CART.	
RL4	4							
RL5	5	SET		+		RNGE	FRM	
RL6	6			MOD		AUTO PRNT	INC DEC	
RL7	7			A				

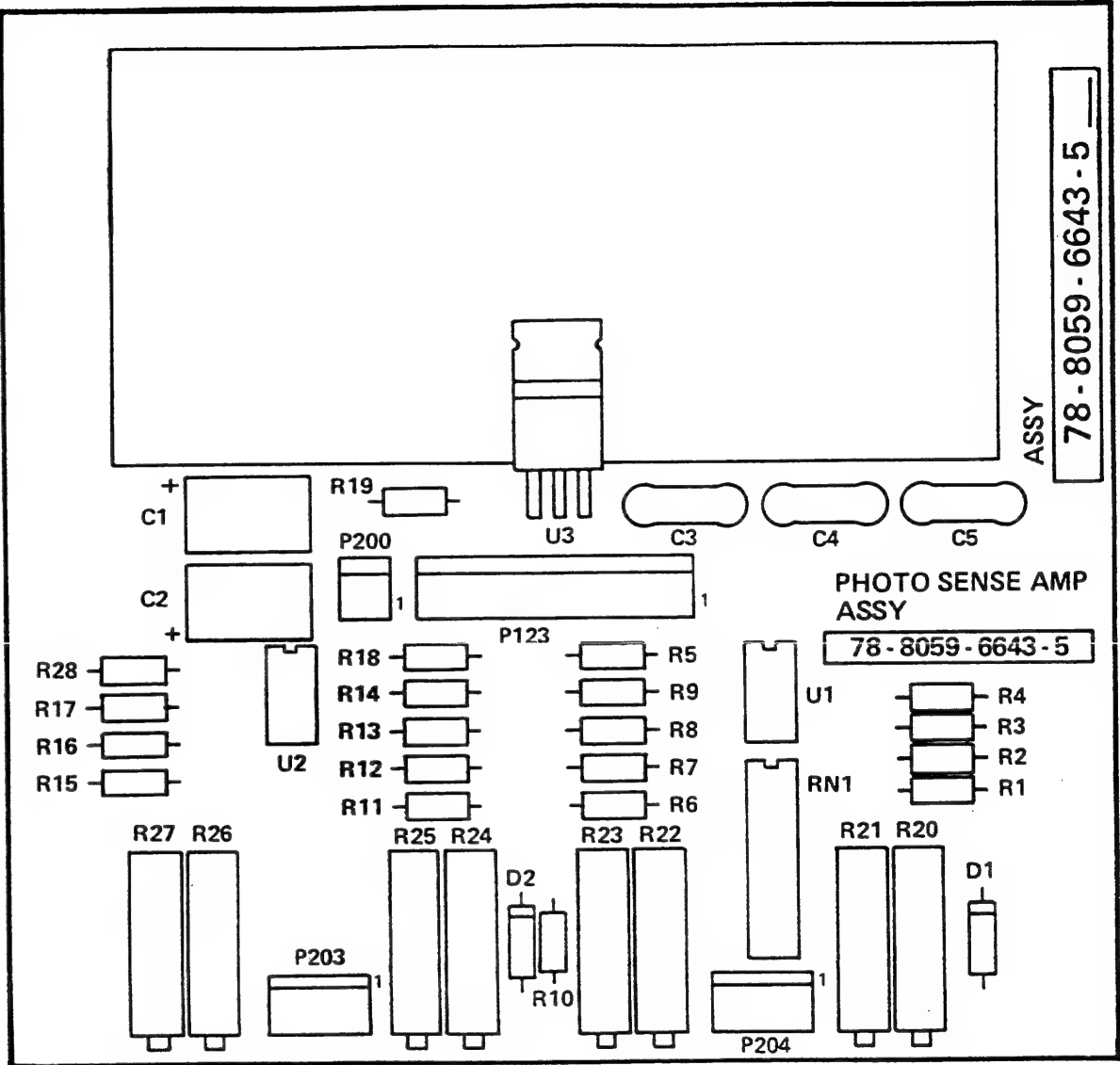
KEY MATRIX



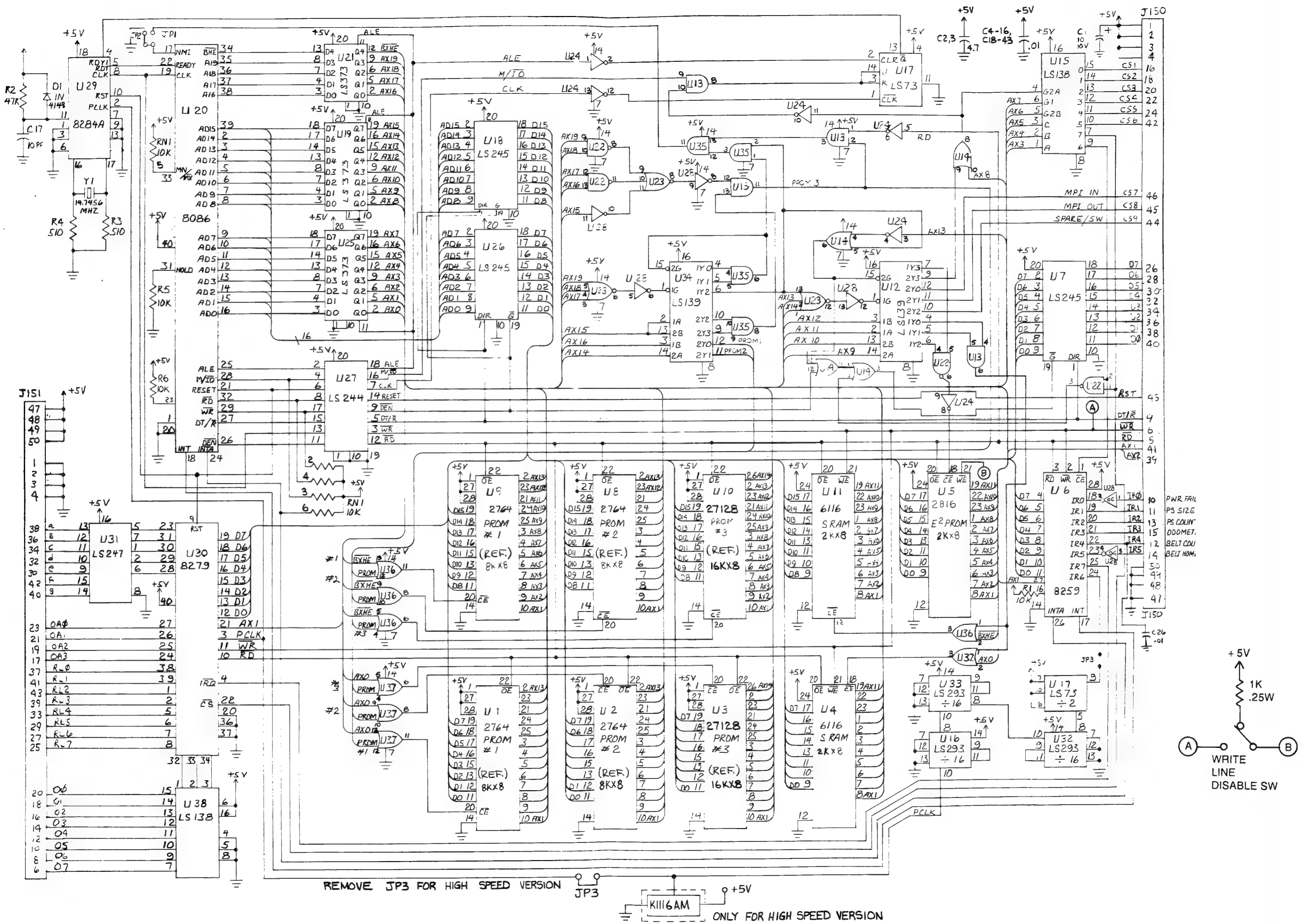
7-2. Photo Sense Amplifier PCB
(Sheet 1 of 2)

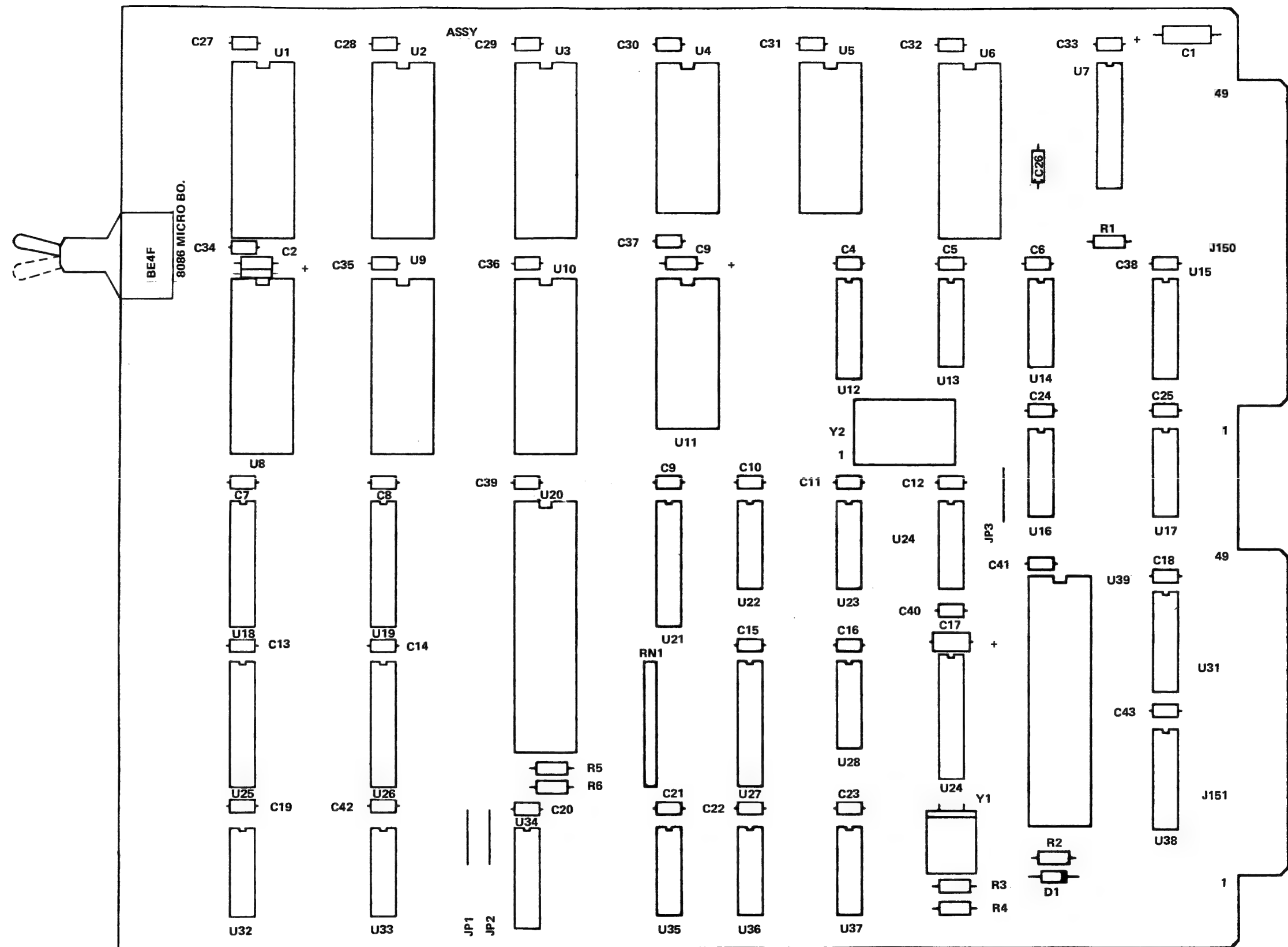


7-2. Photo Sense Amplifier PCB (Cont).
(Sheet 2 of 2)

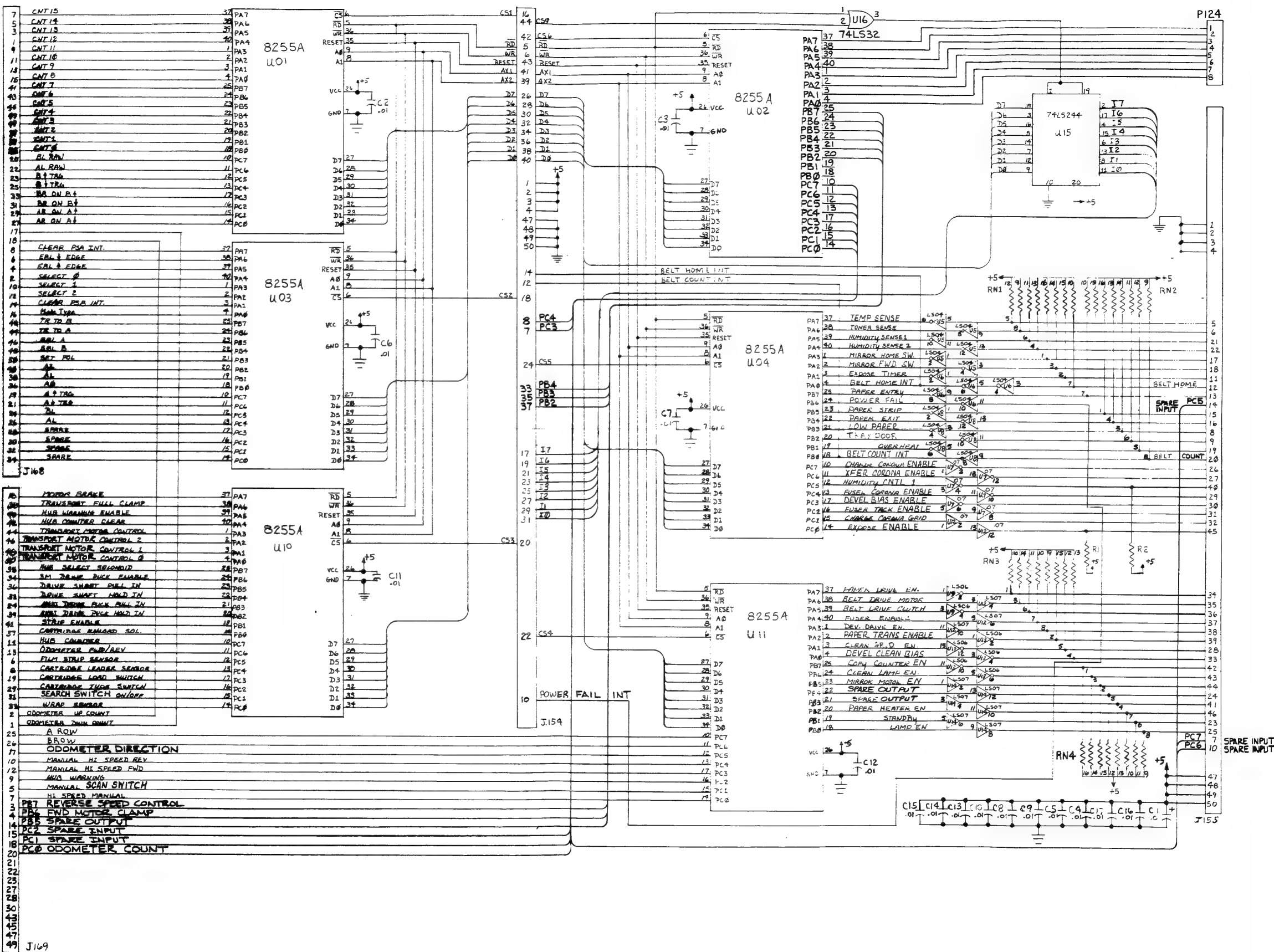


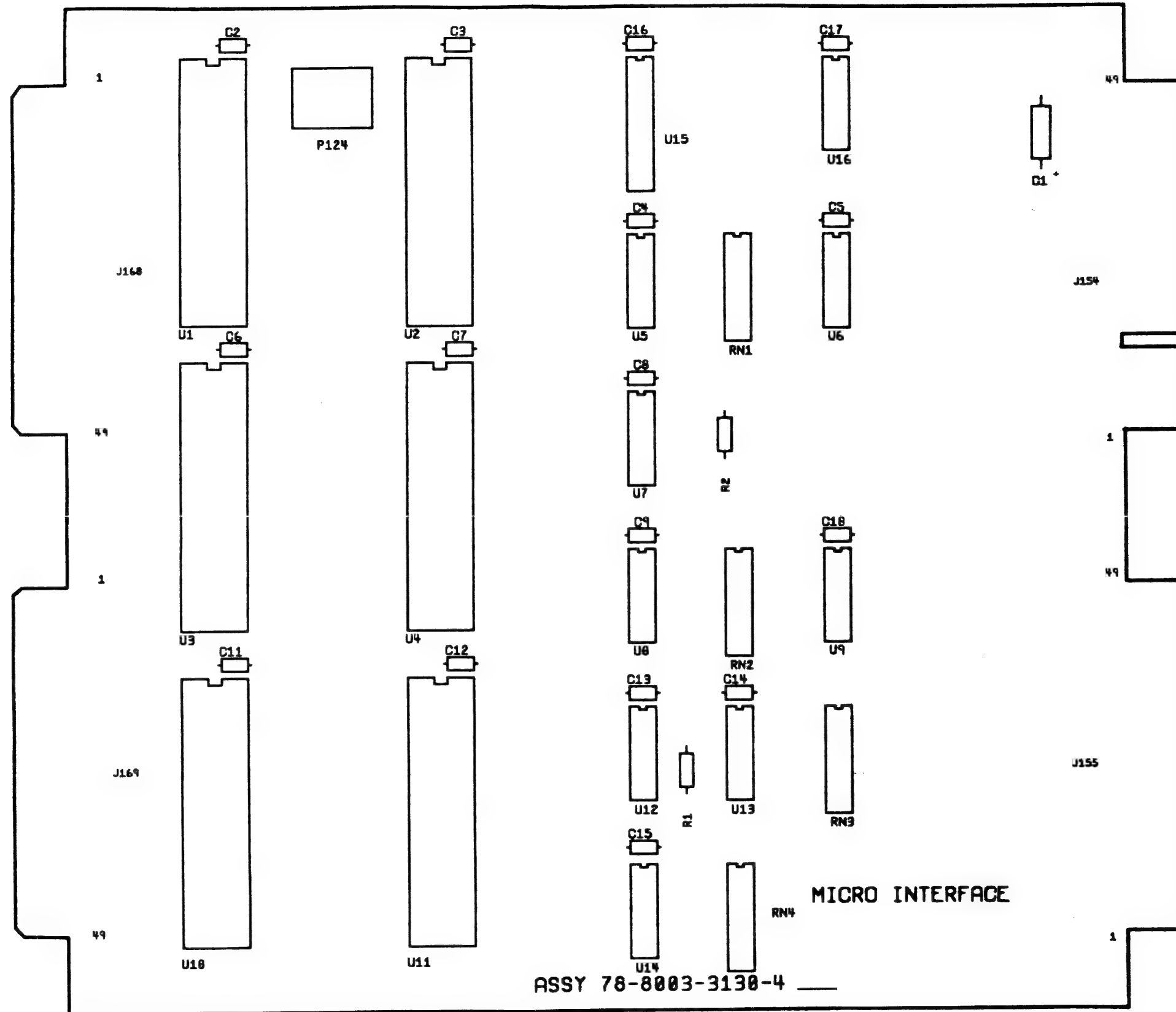
7-3. LED Micro PCB
(Sheet 1 of 2)



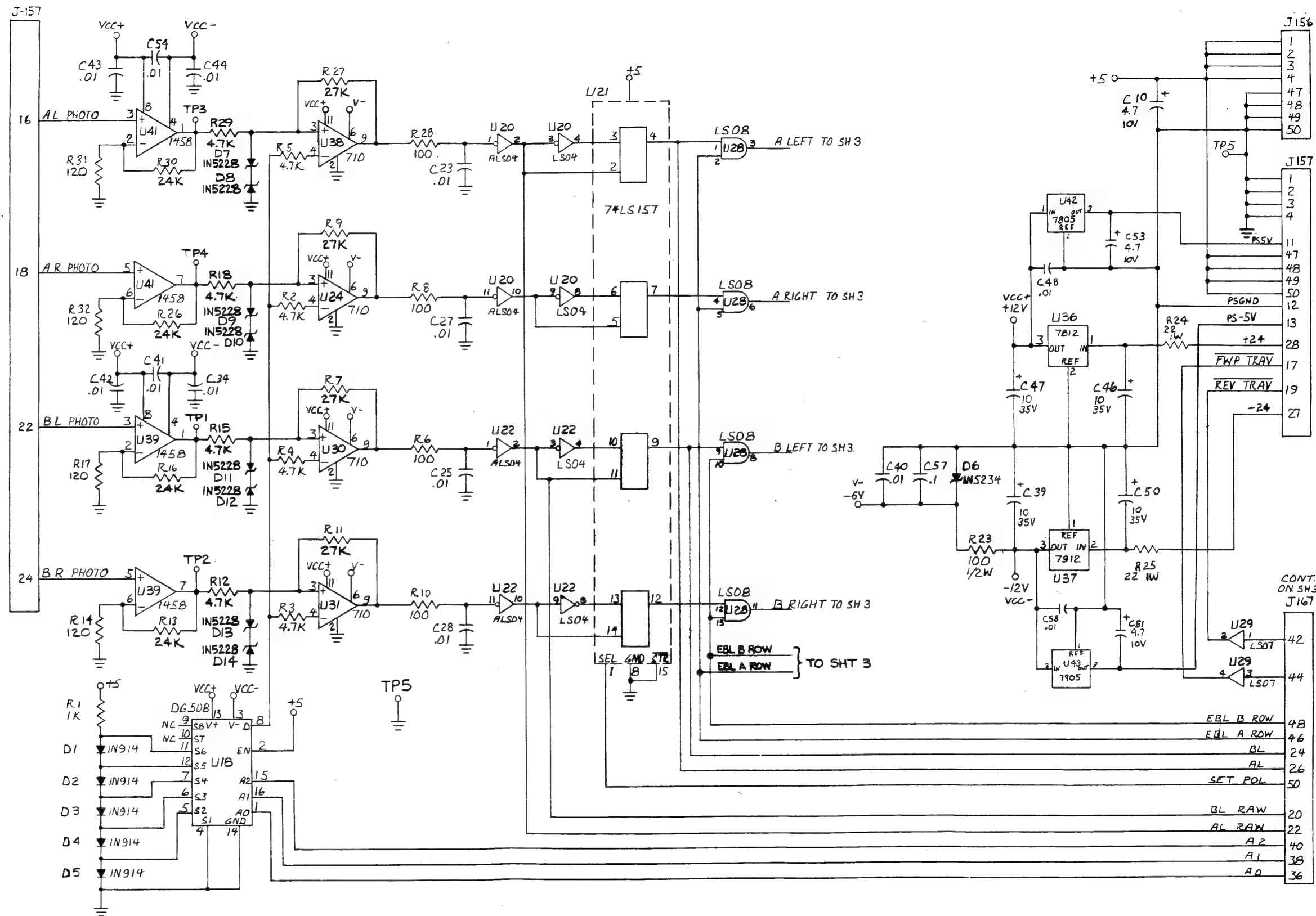
7-3. LED Micro PCB (Cont).
(Sheet 2 of 2)

7-4. Micro Interface PCB
(Sheet 1 of 2)

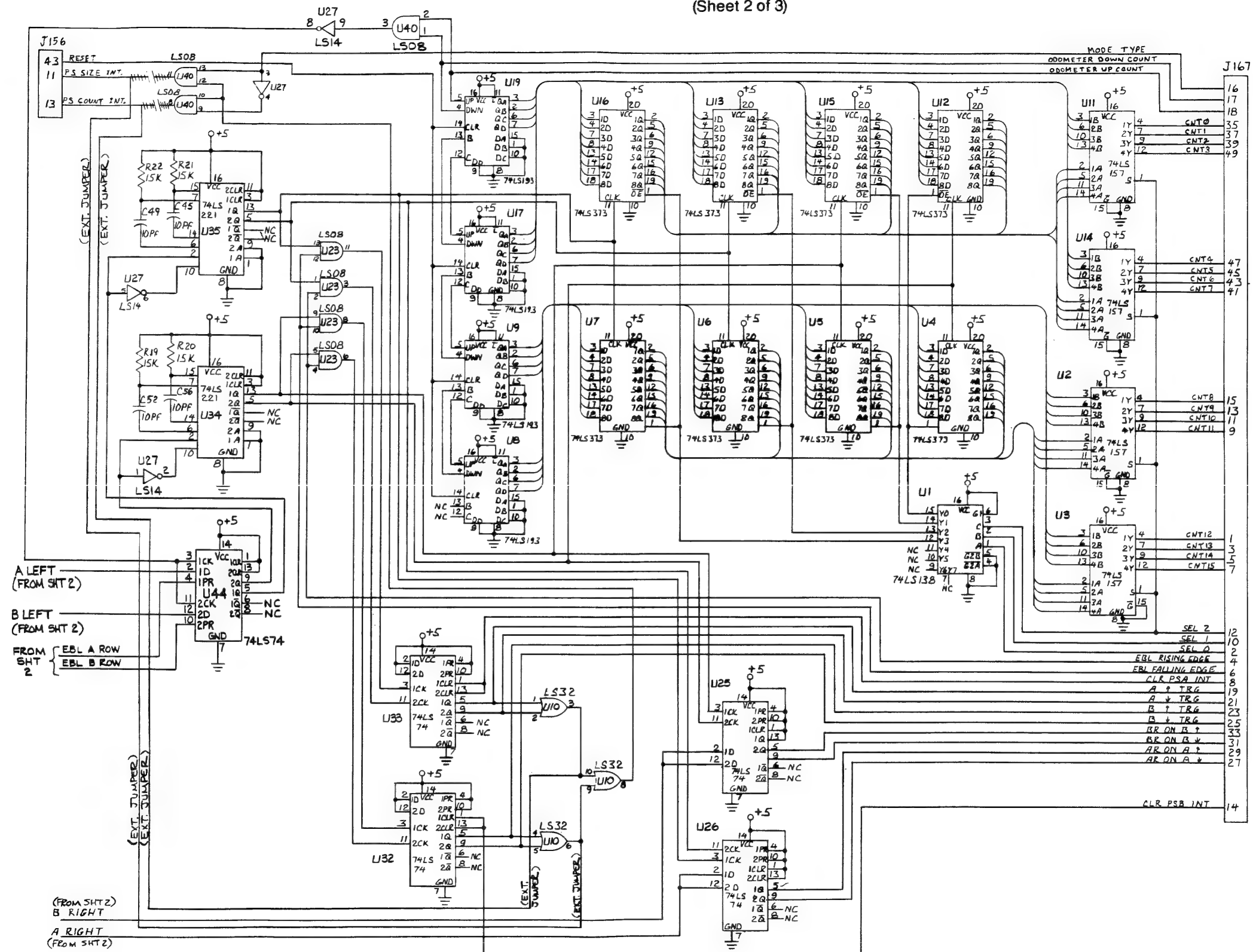


7-4. Micro Interface PCB (Cont).
(Sheet 2 of 2)

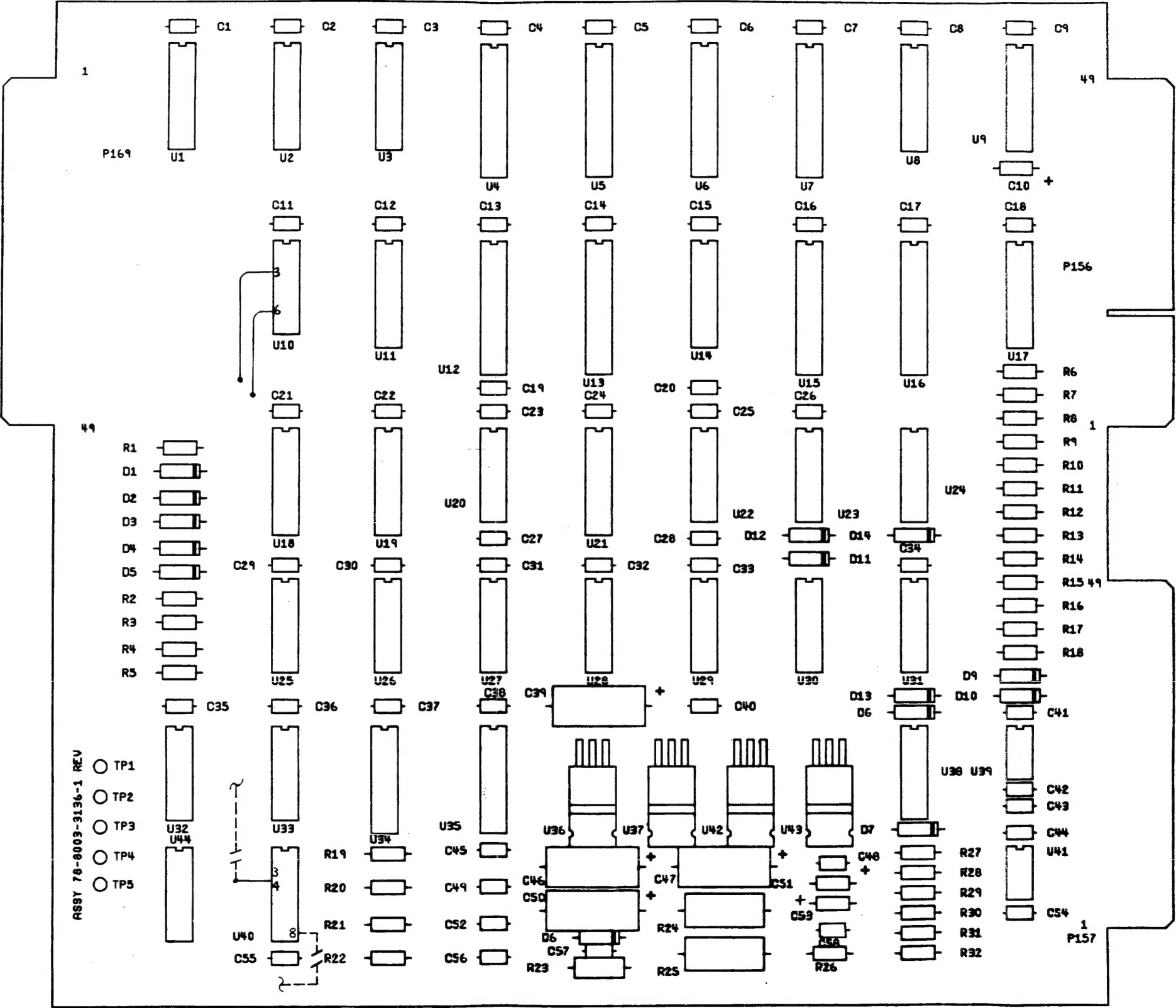
7-5. Page Search PCB
(Sheet 1 of 3)



7-5. Page Search PCB (Cont).
(Sheet 2 of 3)

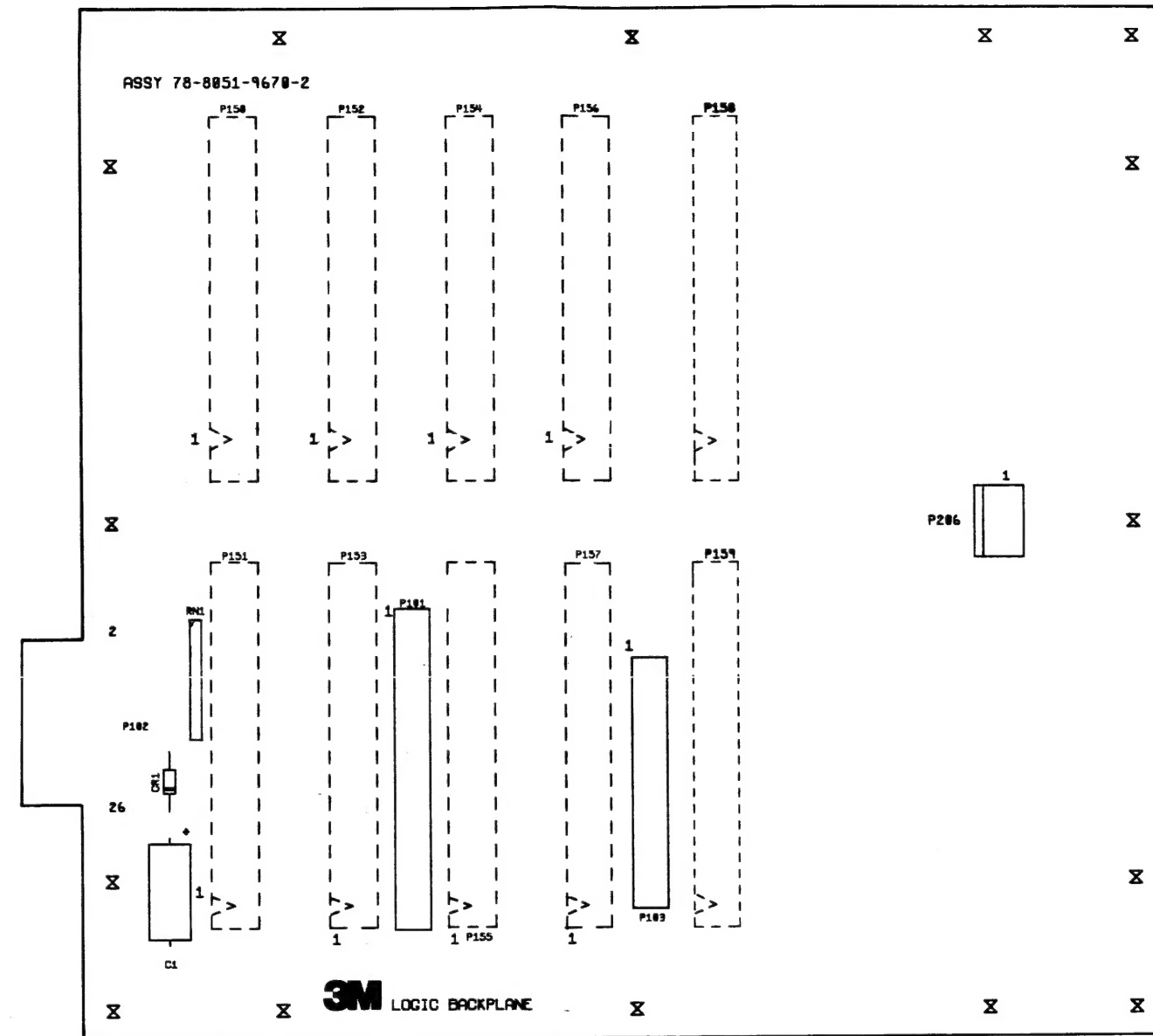


7-5. Page Search PCB (Cont).
(Sheet 3 of 3)



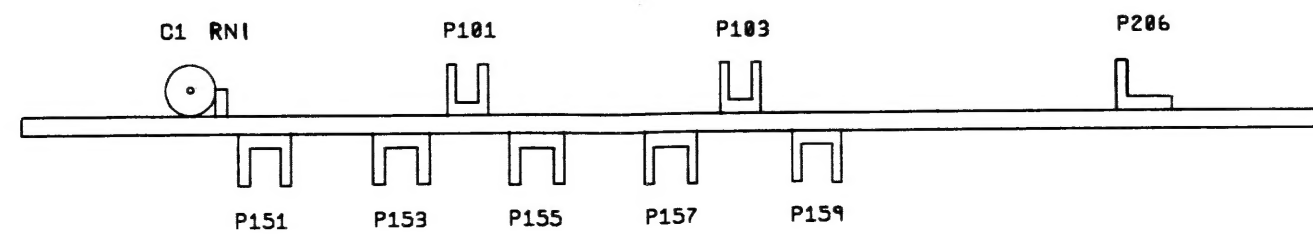
7-6. 656 Backplane
(Sheet 1 of 1)

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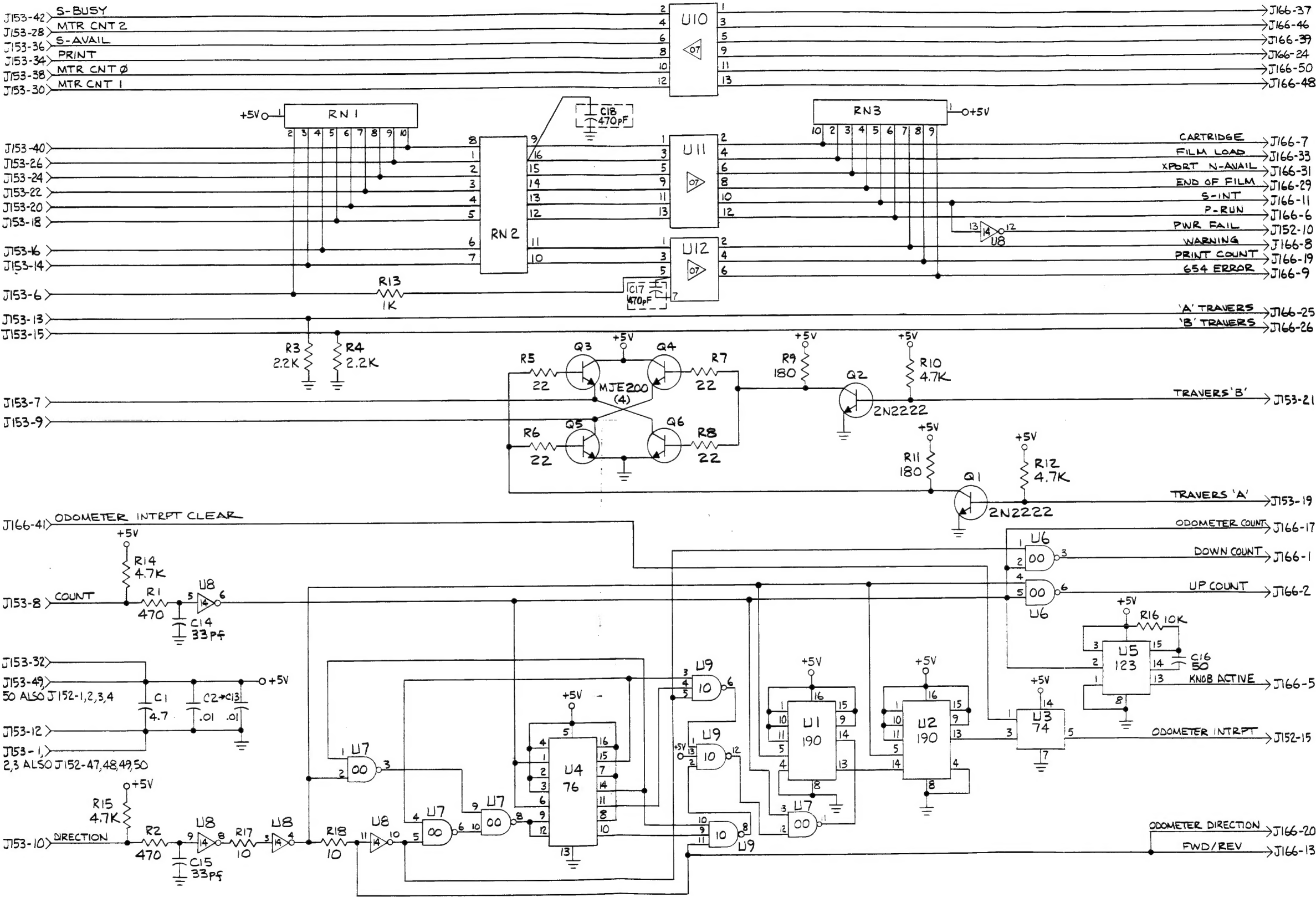


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7-7. 654 Interface PCB
(Sheet 1 of 2)



7-7. 654 Interface PCB (Cont).
(Sheet 2 of 2)